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THE BALANCE DYNAMOMETER.

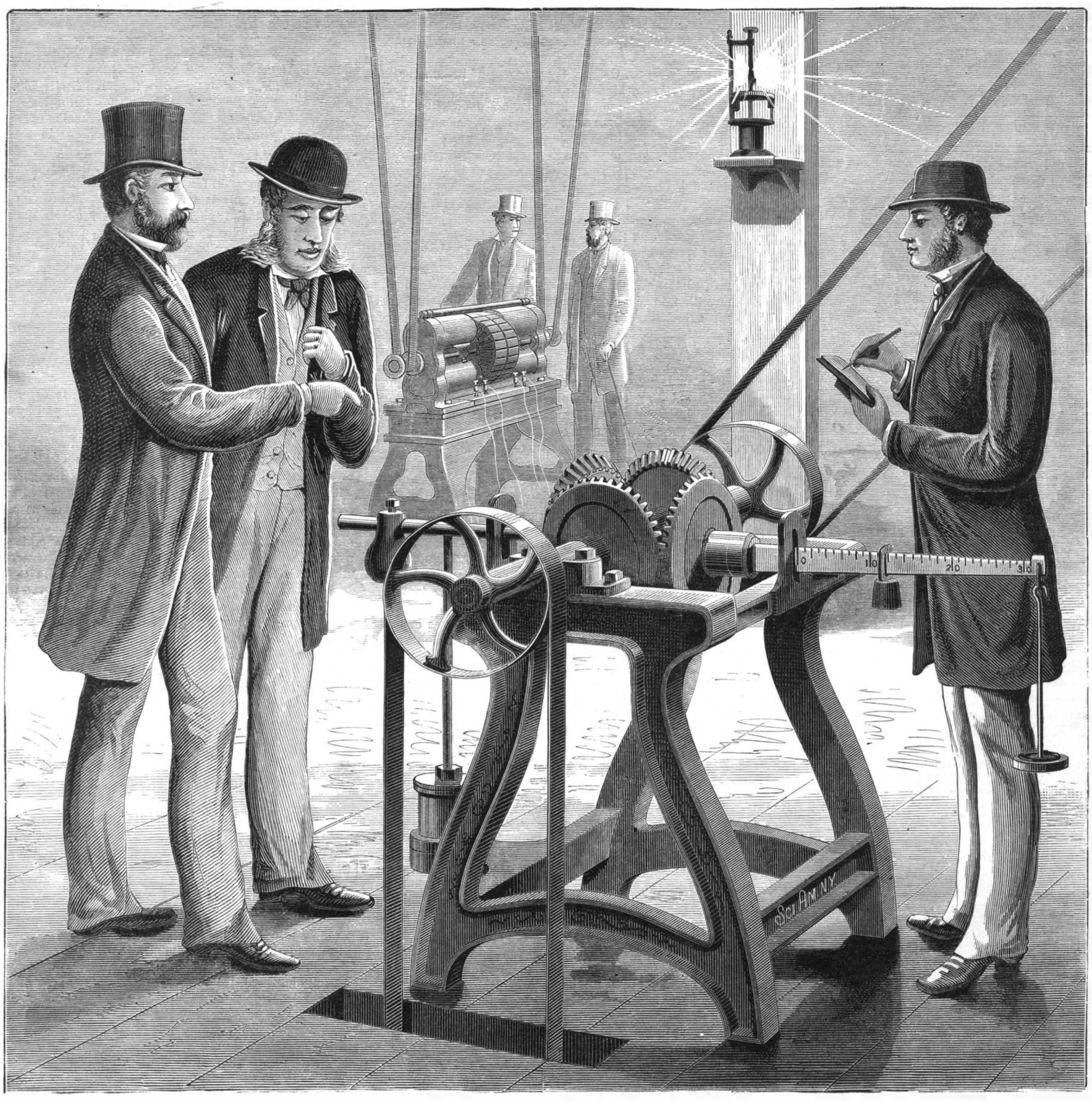
Although many forms of dynamometers have been devised, none of them are more simple or more reliable than the one invented more than thirty years ago by Mr. Samuel Batchelder, of Boston.

This instrument, which is of great value in practical mechanics, is exceedingly simple and is fully adapted to its object. It is made of suitable dimensions and strength for the degree of power to be measured, and when it is used it is placed in the line of communication between the motor and the machinery to be moved; the power exerted on the machinery may be exactly measured by means of the steelyard and weight, which form a part of the machine. There is also connected with it an index to show the number of revolutions of the drum for a given time, which being observed, together with the weight, the data are obtained for computing the number of pounds which would be raised 1 foot high per minute by the power exerted at the time upon the dynamometer and transmitted through it to the working machinery.

Our large engraving represents the dynamometer in actual use in connection with dynamo-electric machines, while the cuts, Figs. 1 and 2, page 132, exhibit the details of construction. In these figures A A and B B are two pairs of belt pulleys, each pair consisting of a fast and loose pulley. The machine receives its power from the prime mover by a belt on the pulley, A, and the power is transmitted to the machine which is the subject of experiment by a belt from the pulley, B. The first pulley, A, and the bevel wheel, D, are fast upon the shaft, C, which revolves in bearings, I. The bevel wheel, F, is connected with the pulley, B, by a sleeve, K, which is capable of turning on the shaft, C. The bevel wheels, D F, are geared together by the bevel wheels, E E, which run upon a cross shaft having a boss, G, through which the main shaft passes freely. It is evident that if this cross shaft is not retained in its place by some adequate force, the motion of the bevel wheel, D, will only cause the cross shaft to move round upon the shaft, C, and the wheels, E, will roll upon the wheel, F, without communicating motion to it or to the pulley, B; but if the wheels, E, and the cross shaft are held stationary, the motion of the pulley, A, will be communicated to the pulley, B, through the bevel wheels, and the force there applied to retain the shaft, G, and wheels, E, in place will indicate the power transmitted through the dynamometer. The amount of power is ascertained by means of a graduated scale beam, H J, connected with the shaft of the wheels, E, by straps, *a*.

The weight, M, fastened to the shorter arm of the graduated beam by a set screw, affords a means of balancing the beam when the machine is at rest, and the weight, W, like that of a common balance, moved on the graduated arm of the lever, will indicate the strain upon the belt. The num-

[*Continued on page* 132.]



BATCHELDER'S BALANCE DYNAMOMETER.

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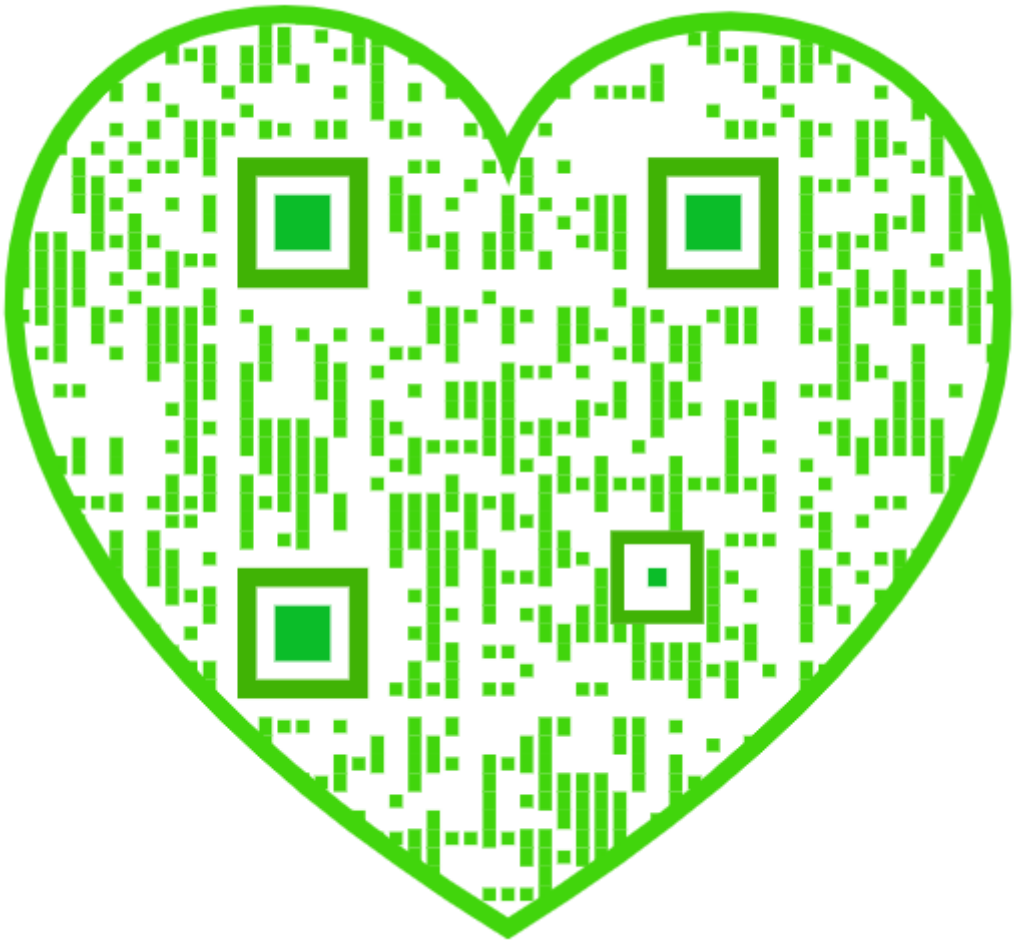

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THE RIGHTS OF INVESTIGATORS.

In the SCIENTIFIC AMERICAN SUPPLEMENT for July 20, 1878, there was published an article entitled "How to Build a Working Phonograph," with working drawings for the construction of a cheap and practical instrument. In the SCIENTIFIC AMERICAN of August 24 we described and figured "a simple phonograph," in such a manner that any clever boy could make therefrom an instrument that would illustrate perfectly the essential mechanism and action of that wonderful invention.

In so doing we have only carried out the wish of the inventor, as expressed to us, in helping to give the widest publicity to his invention. The company which has purchased the right to make the phonograph for commercial purposes, however, take a different view of the matter, and protest that it is not only inconsistent on our part so to encourage infringements, as they term it, but illegal on the part of our readers to follow the directions we have given for making phonographs for experimental purposes. In some instances, we are informed, such makers have been threatened with legal penalties for doing what they have a perfect right to do; and possibly some may be deterred from pursuing their investigations in this direction, through fear of offending the patent law, and so involving themselves in legal difficulties.

The law on this point is not obscure. Investigators have rights as well as patentees; and among these is the right to make any patented article for the purpose of ascertaining its sufficiency to produce the described effect; in other words, for testing its practical utility. It is only when the machine or other article is made for use or sale, with the intent to infringe the patent right and deprive the owner of his lawful reward, that the act becomes an offense against the law. When a machine is made for the "mere purpose of experimenting on the sufficiency of the specification," or—as was held in Jones *vs.* Pierce, Webs. Pat. Cas., 125, Patteson, J.—for the maker's "own amusement, or as a model," there is no infringement.

If this were not the case the progress of invention would be very seriously hindered: improvements would be next to impossible; and practical investigators and students—from whom most inventions come—would be grievously hampered at every stage of their progress. Unfortunately the purchasers of patents are too apt to construe their rights so as to make them cover pretty much the entire universe, and, if they could have their own way, would allow no one to move in any direction without their consent. This may be a natural outcome of human selfishness; but it is not at all in accordance with the spirit of the patent law.

As it appears to us, the parties controlling the phonograph, like the telegraph companies, have missed, or rather have refused to avail themselves of, a most profitable field of operation, in not meeting promptly the eager public demand for experimental instruments. Thousands of instruments could have been sold, at a price affording a large profit, though really low, to persons who would have been glad to buy them as curiosities, or for the purpose of studying their singular properties and effects; this without interfering in the least with the use of more costly and perfect instruments for business purposes. By refusing to meet this proper demand, they have simply compelled investigators to make their own models; and they have no right now to complain.

THE PLANET VULCAN.

After twenty years of dispute, complicated by many doubtful and conflicting observations, the intra-Mercurial planet discovered by the Parisian physician, Lescarbault, will probably now have to be admitted to full standing among the planets. The readers of the SCIENTIFIC AMERICAN will recall the numerous communications and articles with reference to this planet, printed in our issues for October, November and December, 1876, and the more recent article of May 25, 1878, when the belief was expressed that at the approaching eclipse the disputed planet would be found not far from the sun.

Ever since Le Verrier completed his demonstration of the existence of a disturbing body somewhere between Mercury and the sun, not a few astronomers have been convinced that only a favorable opportunity was necessary to verify by sight the evidence of mathematics.

Among these was Professor Watson, whose confidence was so strong that he went to Colorado determined to make the search for Vulcan his chief business. He said to a townsman on his return: "I was satisfied that there was a planet within the orbit of Mercury, just as I am satisfied that there is one outside the orbit of Neptune. The perturbations of those planets, and some other phenomena, cannot be explained on any other hypothesis. So when I went there I fixed on my plan and stuck to it. I determined to sweep south of the sun, and to keep within a small space. We had but three and one half minutes, and the time was too short to try to get over too great a space. I meant to search that much thoroughly, and so reduce the amount for future astronomers should I not succeed. It was on the fifth sweep that I saw the object."

In his report to Rear Admiral Rodgers, Superintendent of the United States Naval Observatory, Professor Watson says. "I have the honor to report that at the time of totality I observed a star of the four and a half magnitude in R. A. 8h. 26m. dec. 18° north, which is, I feel convinced, an intra-Mercurial planet. I observed with a power of forty-five, and did not have time to change the power so as to enlarge the disk. There is no known star in the position observed, and I did not see any elongation, such as ought to exist in the case of a comet very near the sun. I will hereafter report to you fully in regard to observations made. The appearance of the object observed was that of a ruddy star of the four and a half magnitude. The method which I adopted prevents the possibility of error from wrong circle readings; besides I had memorized the Washington chart of the region, and no such star was marked thereon. By comparison with the neighboring stars on Argelander's scale, the magnitude of the planet would be the fifth, although my direct estimate at the time of the observation was four and a half, as stated."

Speaking of the discovery, the English astronomer, Mr. Lockyer, said that he did not look for Vulcan and did not see it, though he believed in Le Verrier's prophecy that it would be found at some time. He added: "We may rely upon Professor Watson's statement that it is not a comet, and it is certainly not a star, therefore it must be a planet, and, from its position, an intra-Mercurial one."

Much to Professor Watson's delight his discovery was in a measure confirmed by that of Mr. Lewis Swift, of Rochester, who was at a neighboring station. Mr. Swift's observation seems to have been, in a sense, accidental, yet there is no reason to question its scientific value. In giving an account of his discovery to the Rochester *Democrat*, Mr. Swift says: "About one minute after totality two stars caught my eye about three degrees, by estimation, southwest of the sun. I saw them twice and attempted a third observation, but a small cloud obscured the locality. The stars were both of the fifth magnitude, and but one is on the chart of the heavens. This star I recognized as Theta in Cancer. The two stars were about eight minutes apart. There is no such configuration of stars in the constellation of Cancer. I have no doubt that the unknown star is an intra-Mercurial planet, and am also inclined to believe that there may be more than one such planet."

AMMONIA IN THE AIR.

Dr. R. Angus Smith, who has done so much for the chemistry of the air, lately read before the Manchester Literary and Philosophical Society a paper on the distribution of ammonia, in which he described the simplest method yet proposed for determining the amount of ammonia in the air. And since such ammonia may be taken as an index of the amount of decayed matter in any locality, the hygienic importance of an easy test for it is not small. The availability of the proposed test arises from the circumstance that ammonia is deposited from the air on every object exposed thereto. "If you pick up a stone in a city, and wash off the matter on its surface, you will find the water to contain ammonia. If you wash a chair or a table or anything in a room, you will find ammonia in the washing. If you wash your hands you will find the same, and your paper, your pen, your table cloth, and clothes all show ammonia, and even the glass cover to an ornament has retained some on its surface." In short ammonia sticks to everything, and can be readily washed off with pure water. Hence Dr. Smith inferred that he might save himself much of the trouble he had been taking in laborious washings of air to determine the presence of ammonia, and gain the desired end by testing the superficial deposit of ammonia which gathers on clean substances during ordinary exposure. Accordingly he suspended small glass flasks in various parts of his laboratory and examined them daily, washing the outer surfaces with pure water, and testing at once for ammonia with the Nessler solution. Subsequently a great many observations were made by means of glasses exposed to air in door and out, where the air was sweet and where it was foul. By using glasses of definite size it was easy to determine whether the ammonia in the air was or was not in excess. In his laboratory experiments ammonia was observed when the glasses had been exposed an hour and a half.

Of the practical working of the test Dr. Smith remarks that it must not be forgotten that the ammonia may be pure or it may be connected with organic matter; and consequently this mode of inquiry is better suited as a negative test to show that ammonia is absent than to show what is present. When ammonia is absent we may be sure that the air is not polluted by decaying matter; when it is present there is need of caution. Dr. Smith adds that he hopes to make this a ready popular test for air, a test for sewer gases, for overcrowding, for cleanliness of habitations, and even of furniture, as well as for smoke and all the sources of ammonia. Of course it must be used with consideration and the conclusions must not be drawn by an ignorant person. The entire paper will be found in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 139.

SOFT VS. HARD IRON.

A series of most careful experiments recently undertaken by Mr. David Kirkaldy, to find out the relative merits of wrought iron plates manufactured by Krupp, of Essen, and those made in Yorkshire, demonstrated that, as regards the elastic limit, or the amount of load at which the elasticity becomes impaired, the result was in favor of the Yorkshire plates by 9·2 per cent, which is attributed to their greater hardness; but that the ultimate or breaking stress was in favor of the Essen plates by 5·5 per cent, the softness of the iron, as shown by the contraction at area of fracture, being also in favor of this latter.

To ascertain the reduction of tensile strength by drilled and punched holes, 42·5 per cent of the plates was removed by rivet holes made in their centers 2½ inches apart between

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centers, and the actual mean loss of strength recorded on the Essen plates amounted to 38·05 per cent, and on the Yorkshire to 42·95 per cent; the difference showing unmistakably the value of the softer iron, and that the ultimate stress borne is much affected by this quality.

Disks 12 inches in diameter and ½ inch thick were then subjected to a bulging stress by being pressed into an aperture 10 inches in diameter by a bulger. The difference in favor of the Essen plates was 17·8 per cent. In resistance to a bending stress also the results showed favorably for Essen plates in both hot and cold bending tests. Some plates showed cracks when bent at angles of 50°, while many of the Essen specimens bent as much as 180° before cracking These results are of great importance to architects and engineers in determining the relative values of soft and hard irons for their purposes.

THE NEW DIVINITY.

It has been claimed that modern socialism, although professedly atheistic, is in reality the beginning of a new religion. The testimony received by the Congressional Labor Committee seems, in the main, to bear out the assertion. However conflicting, in every other respect, might be the views of the socialistic reformers that thronged the committee room, they all seemed to be in substantial accord on one point, namely, the source from which relief from all industrial troubles was to come. Their sublime confidence in the beneficent capacity and character of this new divinity would have been beautiful if it had not been so absurdly ridiculous—ridiculous as every phase of fetich worship must be to those who have passed beyond it.

The troubles that afflict the poor are traced by socialists chiefly to the oppressions of capital made possible by the maladministration of government, itself corrupted by human selfishness and dishonesty. In the interest of hereditary wealth and position government does no end of wicked things, and neglects to do justice to the poor in almost everything. Indeed, in whatever governments may undertake to do, jobbery and favoritism on the part of those empowered to direct the work invariably result in a squandering of the means provided, and almost always in an increase of the burdens of the poor, with no compensating benefit. Down with the Government! Oust the rascals that in the name of justice plunder the public treasury, and share the spoils with the rich, who use their ill-gotten gains for the oppression of their betters, the producers!

This is the socialistic cry, from Russia to San Francisco. Yet, like the poor savage of Ashantee who makes a god of the snake that bit him, the one unanimous demand of the socialists before the Labor Committee was that government should undertake to do everything.

By what process of mental jugglery the idea of government is separated by them from human agency and made a god to do impossibilities—incorruptible and of unfailing wisdom—there is no means of telling; yet the fact remains that these unfortunate victims of government, according to their own account, want nothing so much as more government. In the name of liberty they demand the most absolute of despotisms. Denouncing the incompetence and rascality of all men in power, they would turn over to government (and so, of course, to the control of officials) all the means of wealth, all the processes of production, all the distribution of this world's goods. In future years this feature of the socialistic movement will, we believe, be looked upon as one of the most curious and unaccountable of epidemic delusions.

With not a few of the objects of the socialistic reformers we are in hearty sympathy. To no small degree they are working at, if not working out, the true aims of American institutions, as they themselves will discover in time, when they come to know more about our institutions. When to their zeal they add knowledge—practical knowledge, not idle dreams and mischievous misapprehensions—they will see, as others do now, that they are largely fighting shadows of their own creation. And they will discover too that it is sheer madness to make a divinity of the popular will, as expressed by government—the necessarily rude adjustment of conflicting individual wishes and interests, executed by fallible individuals. A government of the people, for the people, by the people, may be the very best government possible for a free people; but to make a god of it, putting upon its shoulders all powers and all responsibilities, in the hope of ushering in the millennium thereby, as socialists threaten, is a scheme worthy only of the madhouse.

THE WEST AS A FIELD FOR MANUFACTURES.

The rapid progress of manufactures westward during recent years has been noticed in this paper frequently. Already the Western markets are to a great extent commanded by Western industry; and the tendency is to make that part of the Union each year more and more independent of the factories of the East and of Europe. Thus far in the competitive struggle two factors have told strongly in favor of the Western manufacturer—nearness to market, and a closer knowledge of and sympathy with the special wants of his customers. There is another factor which promises to help still more the development of the manufacturing industries of the West, a factor which Eastern men have been slow to appreciate; and that is the superior natural facilities of that region, especially the Northwest, arising from the abundance and permanence of its available water power and the even greater abundance of coal. In the SCIENTIFIC AMERICAN SUPPLEMENT Number 140, will be found in full a notable article from the Chicago *Journal of Commerce*, with relation to this matter. The Northwest is shown to be especially rich in rivers affording large and uniform currents and abounding in valuable mill sites. Wisconsin, Minnesota, and Iowa have a score of such rivers furnishing available power equal to that of the most prominent power furnishing rivers of the East. In any of these States can be found rivers like the Des Moines of Iowa, or the Fox of Wisconsin, able to run all the machinery in New England and New York. The force available at Minneapolis alone is estimated at 120,000 horse power. In the three States mentioned, the *Journal* counts fifty rivers from 150 to 600 miles in length, which possess every requisite as first class mill rivers; and each of these has numerous tributaries a hundred miles or less in length, abounding in valuable mill sites; rivers fed by lakes and other natural reservoirs, which supply a strong and almost unvarying current the year round. Besides, owing to the natural advantages of the bed rock of Western mill sites, the average cost of dams and other structures for commanding water power in the West has been only about two thirds that of similar constructions in Eastern States.

The extent to which the water power of the Northwest is already utilized is but imperfectly appreciated even in the West. "In the single industry of the flouring trade," says the *Journal*, "we find its rivers turning the wheels of two thousand of the twenty-five hundred flour and grist mills. A thousand manufactories of agricultural implements and machine shops are already established, and the wagon and furniture factories are legion. Woolen and cotton mills, tack and nail factories, and in fact all the higher grades of manufactories have already discovered the advantages which our rivers offer for their location." The Mississippi valley must ultimately furnish homes for ten times as many people as the whole of the United States now contains. As that time approaches these splendid facilities for manufacturing enterprise will make the Northwest the busiest and wealthiest region in the world. With every new manufactory the need of sending corn and wheat and beef and pork half way round the world to find a market will be lessened, to the farmer's gain and the general advantage of the commonwealth. Indeed the combined advantages of the Northwest, in possessing a fertile soil, abundant mineral wealth, a plenitude of available water power, a healthy climate, and a vigorous and thrifty population, make it, it seems to us, a field for manufacturing and other industrial enterprises second to none in the Union. And the recent emigration to that region of thousands of thrifty mechanics and artisans from the East indicates very plainly that its industrial future is being rapidly determined in the right way.

PNEUMATIC ENGINES FOR STREET CARS.

The substitution of compressed air motors for horse power in street car traffic has for some time been under consideration by the Second Avenue Street Railway Company of this city, and it is now claimed that the prospects of a successful issue are most satisfactory. An experimental car was run over the Harlem portion of the road, August 3d, and behaved so well that the company propose to dispense entirely with horse power on that part of their road as soon as a sufficient number of engines can be constructed. Ultimately they hope, it is said, to extend the improvement to the whole distance from Harlem River to Peck Slip.

Externally the new self-propelling car resembles the ordinary street car, the compressed air reservoirs and other machinery being under the floor and out of sight. In the trial trips a speed of from sixteen to eighteen miles an hour was obtained. The movement of the car is controlled by a brace of levers on the front platform, and involves nothing, it is said, beyond the skill of an ordinary car driver. The capacity of the two reservoirs is sufficient to drive the car from Harlem River to Peck Slip and return. A seventy-five horse power steam engine at Harlem is used to charge the reservoirs, five minutes being sufficient to do the charging. The inventors of this method of propelling street cars are Messrs. Robert Hardie and J. James, of Glasgow, Scotland.

Another compressed air motor for street cars, the invention of Mr. Henry Bushnell, of New Haven, Conn., was successfully tested a few days since in that city. Mr. Bushnell's air receivers are tubes, the largest of which are twenty feet long and only eight inches in diameter (those of the Hardie & James car being two feet in diameter). There are four of these, two on each side of the car above the axles and next the wheels. Between them at the end of the car are four other tubes, each six feet long and six inches in diameter, inside measurement. The double cylinder engine which drives the wheels does not differ materially from a steam engine, except in the smallness of the cylinders, which are only 2¾ inches in diameter. By an ingenious device the cylinders are kept warm by a small air compressor attached to the running gear of the car. Great advantage is claimed by Mr. Bushnell for the long and slender receivers; a pressure of 2,000 lbs. per square inch giving in them a pressure of only 50 tons on the head of each tube, while the two-foot receivers of the Second Avenue car, he says, would have to stand a pressure of 180 tons with the pressure of 800 lbs. to the square inch claimed by the inventor. A gentleman who was present at a trial trip reports that the motion was easy and at times about twice as rapid as that of a horse car. The new vehicle obeyed the engineer promptly in starting and stopping. The distance traveled in going and returning was a little over a mile. At the start the gauge registered 1,800 lbs. At the return the pressure indicated was 1,500 lbs. When the air was allowed to escape from a turned cock the roar was frightful and was as irritating to the ear as escaping steam. In running, however, very little noise is heard from the escape pipe, because the escaping air is made to pass through a mass of ordinary curled hair. This device Mr. Bushnell esteems one of the most important of his inventions. He has no doubt that it would prove equally efficacious in deadening the sound of escaping steam. In running the distance of four miles the pressure was reduced from 1,950 lbs. to 750 lbs.

Whether either of these motors will stand the test of winter use, with snowy or frosty rails, remains to be seen.

A FALSE ALARM.

The New York *Herald* of August 15th set off its regular Washington correspondence with the startling head lines: "*Important Decision of the Attorney General.* THOUSANDS OF PATENTS INVALIDATED." The text of the letter was quite as alarming as its title—to those who did not recognize its absurdity. Fortunately, however, few inventors or patentees are so ignorant of the practical working of the patent system as to be misled by such wild talk about the invalidation of "between forty and fifty thousand live patents." According to the *Herald* writer, the Attorney General's decision is in effect that "letters patent issuing to two or more persons, when but one of them is the real inventor, are void, and cannot be made valid by any act of the parties concerned or by the Patent Office."

The decision is in reality nothing of the sort, the unintentional misstatement of its effect arising from the omission of the words *as joint inventors* after "persons."

The occasion of the decision was this: In 1871 Joseph Barsaloux invented a device for stiffening boot and shoe heels. Before applying for a patent he sold to James & Lyon two-thirds of his right. In 1872 a patent was applied for, and in the application the three men were—"by the misadvice of their attorney and their own ignorance of the law"—described as joint inventors, instead of following the regular practice in such cases of naming the first as inventor and the others as assignees. The patent was issued in accordance with the terms of the application. Subsequently, in 1875, James & Lyon discovered their error and applied for a reissue to Barsaloux alone. In the opinion of the Commissioner of Patents the new patent asked for could not be legally granted, the original patent being void through no fault of the department, and the invention having been in public use for more than two years. His opinion was referred to the Attorney General for an authoritative decision, and the position taken by the Commissioner was sustained in the following terms:

"The error here presented consists of a false suggestion in the original application that the invention was joint. This, whether done through ignorance or by mistake, does not, in my opinion, afford any ground for the action prayed for. The patent issued upon that application must be deemed to be void, as a joint patent cannot be sustained upon a sole invention of one of the patentees (see 1 Mason's C. C. Ref., 473), and the department cannot by means of alterations or corrections confirm or impart validity to a patent which was originally void."

As will be readily seen, this decision imports no new principle or practice into the working of the patent system, and will have no such effect as the *Herald* writer describes. Unless the partners of an inventor have deliberately sworn to a falsehood, claiming to be joint inventors when in truth they were not, they need have no fear of the validity of their patent; and no competent patent attorney would allow such a mistake to occur through inadvertence.

THE WALLINGFORD TORNADO.

On the evening of Friday, August 9, a tornado swept over a portion of the village of Wallingford, Conn., killing outright between twenty and thirty persons, and wounding many more, some of whom have since died. Forty dwelling houses were demolished, besides a church, a school house, a factory, and fifty barns. Nearly all the dead were crushed by falling timbers. The tornado appears to have been confined to a belt of territory less than half a mile wide and two miles long, the whole damage and loss of life occurring on a strip of sand plains of small extent. Severe thunderstorms, in some cases attended with much hail, were general throughout New England that day.

Measured by the loss of life this is by far the most destructive tornado that has been experienced in the East; it was not, however, of unique severity. Some forty years ago the same region, almost the same locality, was swept by a whirlwind of even greater force, though fortunately it did not encounter any human habitations. Still earlier, in 1787, a more fatal and possibly in other respects more destructive tornado struck the country between New Britain and Weathersfield (directly north of Wallingford), and passed on to Eastbury, doing great damage; and it was noticed in the Hartford *Courant* of that time that a previous hurricane had swept substantially the same track, the centers of the two being only 33 yards apart. All these storms occurred in August.

There is a prevalent opinion that violent tornadoes are rare in the East, and that the unobstructed sweep of an open prairie country is needed for their full development. They are more common in the West, it is true; but it is probably due not so much to the more favorable conditions prevailing there as to the fact that the West is very large compared with the East. If equal areas be compared, the Eastern States will probably be found to suffer from whirlwinds as frequently as the West.

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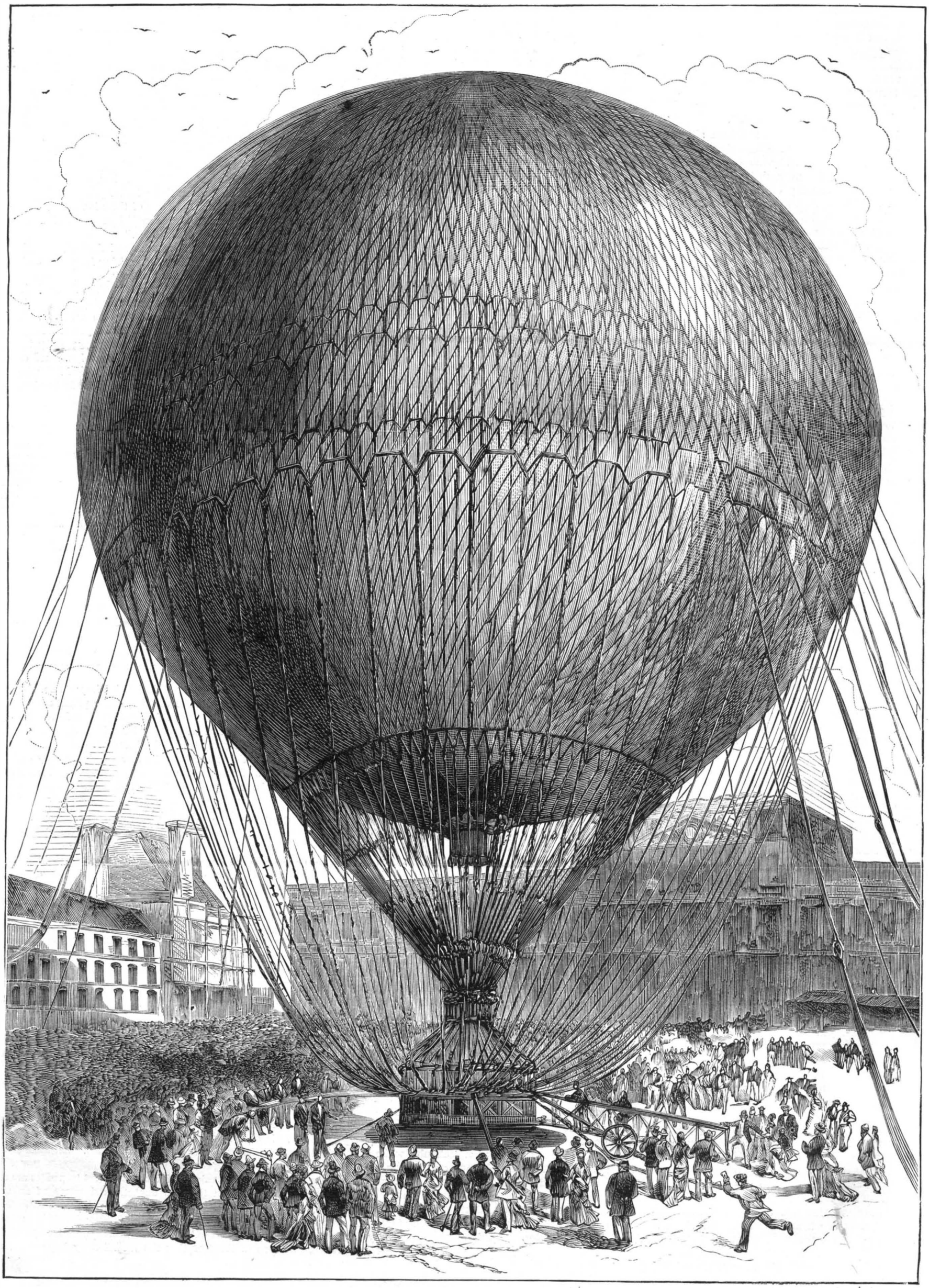
CAPTIVE BALLOON OF 1878.

The 'captive" balloon now inflated in the Place du Carrousel of the Tuileries is an object of wonder to Paris at the present time. Viewed from the Arc de Triomphe or any part of the main drive of the Champs Elysée, half of its full height shows above the western façade of the Tuileries, and we observed it plainly in view a day or two since when at Petit-Bourg, 30 kilometers (19 miles) from Paris, when attending the trial of plows at that place.

Its size is something extraordinary, and we shall merely give the figures, omitting the glowing description of the appearance of this remarkable city, which shows better than most others at a bird's-eye view, owing to the size of its main streets, the large buildings and parks, the green avenues, and the winding course and wide quays of its beautiful river.

The balloon has a diameter of 118 feet, and stands, when inflated, 180 feet high. It has 43,057 square feet of surface, and the weight of the envelope is 8,800 pounds. It has eight superposed adherent tissues, of alternating silk and caoutchouc, the outer fabric being varnished and painted



GIFFARD'S CAPTIVE BALLOON OF 1878.

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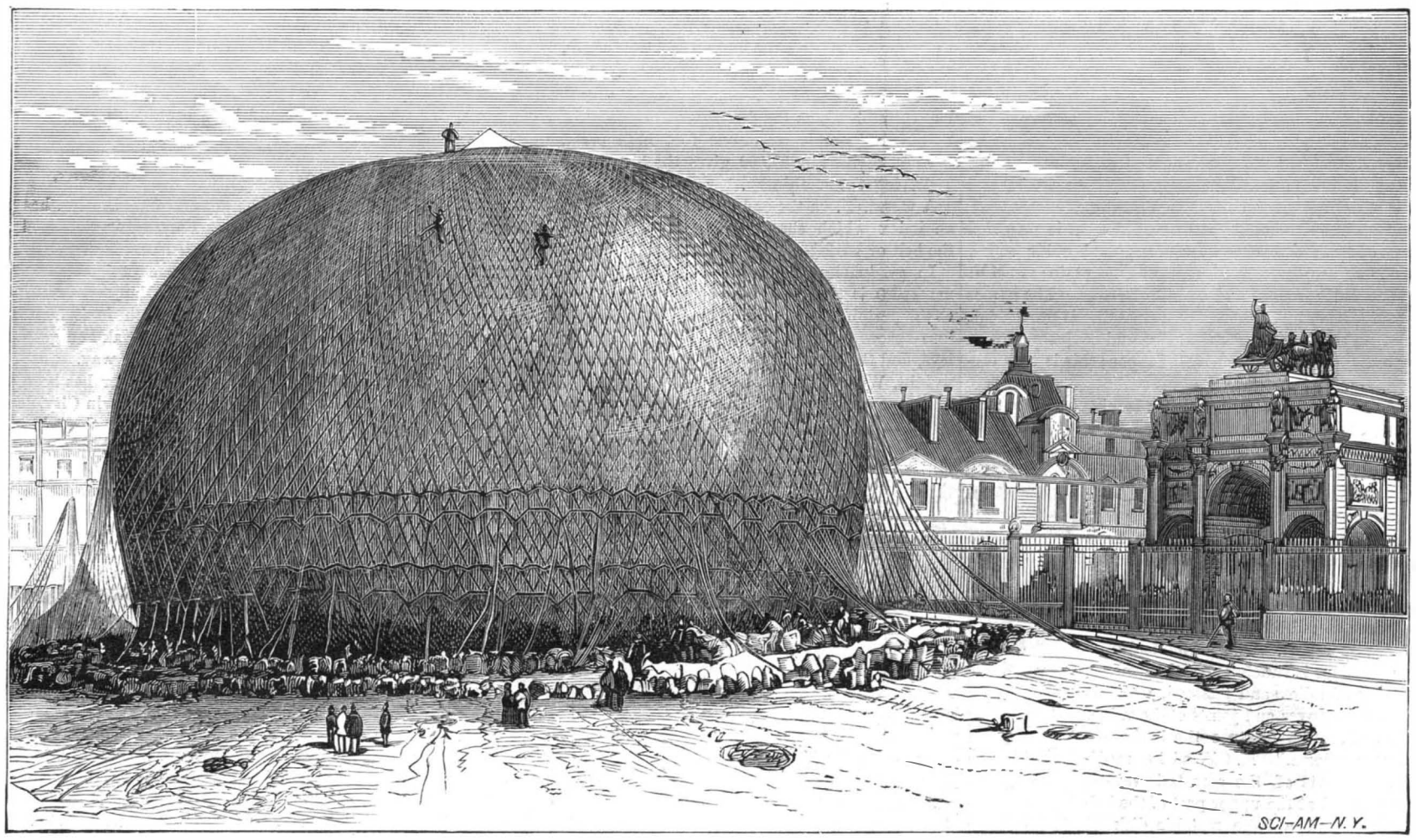
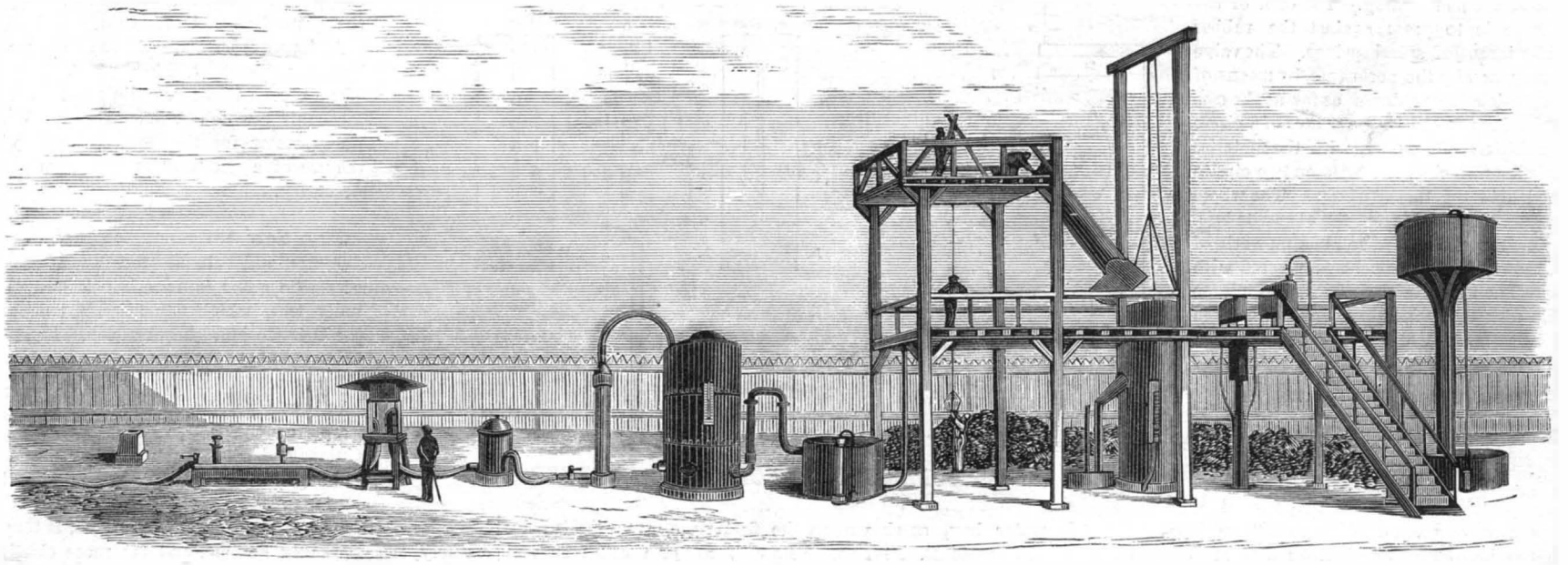
with zinc white; 4,000 meters of material which is 1·10 meter wide are used for each layer, the excess of 0·10 meter being overlap for sewing the silk or uniting the gum goods, as the case may be. Each meter of surface costs 14 francs. The cord netting is 11 millimeters in diameter and weighs 6,600 pounds.

The cubic contents are 847,598 cubic feet, and the cost of the whole enterprise a little over $100,000. The height of ascension is 600 meters (1,968 feet), and the charge for each person 20 francs. The car is annular, being 6 meters in diameter, forming a circular gallery 1 meter wide, with partitions, around a central aperture of 4 meters. It carries 50 persons at a trip, estimated at an average of 60 kilos each; total living burden, 3,000 kilos. (6,600 pounds).

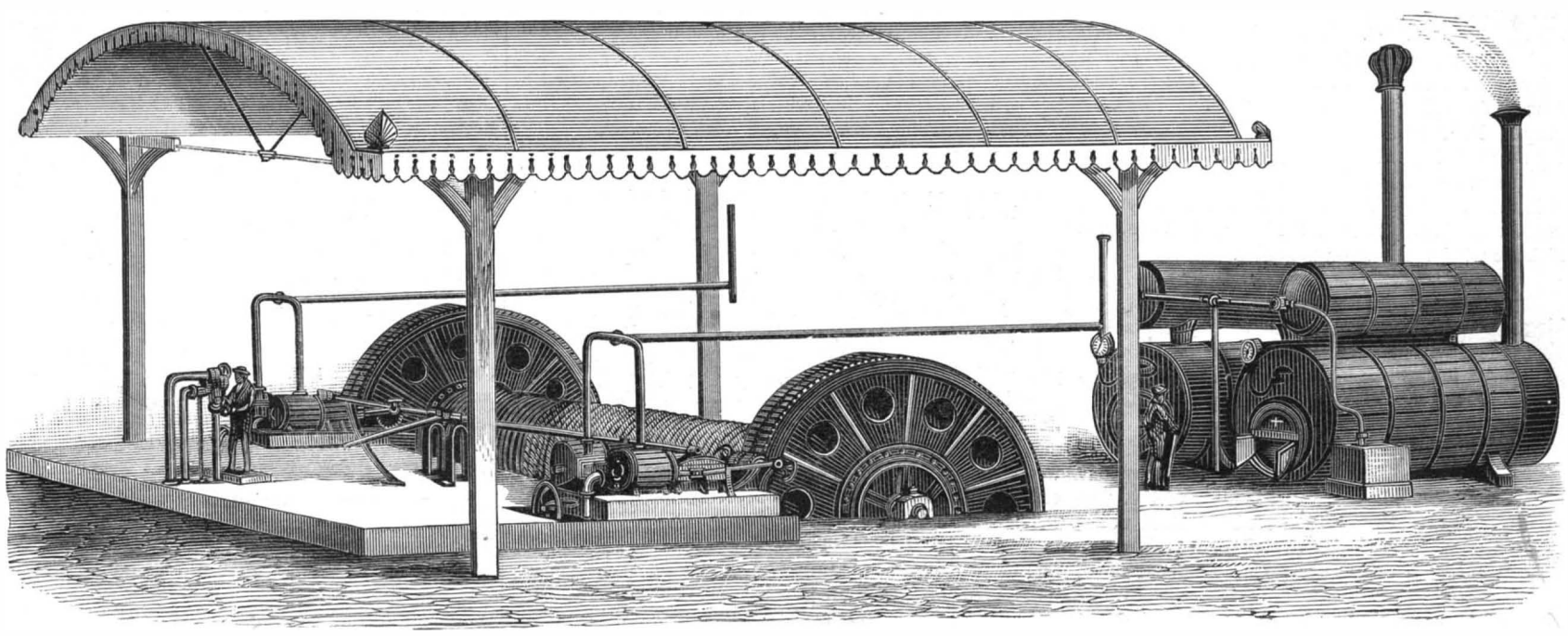
The cable traverses an underground tunnel in its passage from the winding engine to the balloon. The inflation takes a week of time, at a cost of 62,000 francs, the gas being hydrogen, obtained by the chemical reaction of 100,000 kilos. of iron, 200,000 kilos. of acid, and 500,000 liters of water. The gas traverses a series of purifiers, and is collected in a large reservoir and thence passes to the balloon.



THE INFLATION OF THE BALLOON.



APPARATUS FOR MANUFACTURING GAS FOR INFLATING THE BALLOON.



THE WINDING MACHINERY.

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The winding engines for the cable are each 30 horse power, and wind in at a rate of 30 turns per minute, the average length of a turn on the barrel being nearly 20 feet. The cable weighs 4,400 pounds, and has a proved strength of 200,000 pounds.

The captive balloon ("Geant") of Mr. Henry Giffard in 1867 had a capacity of 5,000 cubic meters, and its ascent was 300 meters (984 feet). She carried up 12 persons at a trip The size of the present one may be repeated for the sake of comparison, the cubic capacity being 25,000 cubic meters, its load 50 persons, and its elevation double that of the former.

The first question that naturally presents itself to the mind of every one who contemplates making an ascension is: "What would happen should the cable break?" Such an accident is scarcely within the range of possibility. Still, everything should be foreseen; supposing it should break! Well, the aerial voyager would have a more extended excursion, that is all The double bottom of the car is provided with bags of ballasting, grappling irons, and guide ropes, and the aeronauts chosen by M. Giffard as Captains are MM. Eugene and Jules Godard and Camille Dartois. The names of these aeronauts are as popular as their ability is proverbial. In case of an accident their knowledge and coolness may be relied upon. But no accident will happen; this is very certain.

As a further provision against such a barely possible event, however, the captive balloon is provided with certain pieces of apparatus that are found in ordinary balloons, but in this case in a greatly improved form.

Balloons are furnished at their upper part with a wooden valve, formed of two flaps which open from the exterior to the interior by means of a cord which is under the control of the aeronaut; these close automatically under the action of rubber straps which extend over their upper part. The hermetical closing of these flaps is rudely effected by means of a mixture of tallow and flaxseed, which is applied to the grooves and joints of the valve. Aeronauts give this mixture the barbarous name of "cataplasm." M. Giffard has modified all these parts of the aerostatic valves. The one situated at the upper part of the balloon is formed of a large metallic disk 22 inches in diameter, furnished on its upper side with a circular metallic projection which, resting against a crown of India rubber, produces a hermetical sealing. The disk of the valve is made to press against the rubber crown by means of spiral springs. The valve may be opened by the aeronauts by means of a cord which hangs down as far as the car. The valve is mounted in the center of a circle of very thick stuff, which, with the material of the balloon, is clamped between two circles of wood held together by bolts. The whole apparatus is protected from the elements by a sheltering tent made of a solid framework of wood, mounted on springs, and covered with canvas. The lower valve is formed of a large metallic disk 32 inches in diameter, held in place by very delicate springs. This disk opens automatically, under a very weak pressure, to allow the escape of the excess of gas due to dilatation. This valve, like the upper one, is mounted in a collar of thick material, which supports, in addition: (1) the tube through which the balloon is inflated; (2) a metallic piece through which the cord of the upper valve passes; (3) a glass "bull's-eye" through which the interior of the balloon may be examined; (4) a manometer. Around the large circle of the valve has been fixed a series of layers of India rubber to prevent the balloon from "bagging" under the action of the wind, and to keep it always distended. The spring balance which unites the balloon to the cable is suspended in the center of the annular space surrounded by the gallery of the car. This balance is formed of two steel cylinders united by light iron springs. Four vertical dials indicate, by means of hands, the amount of traction in kilogrammes to which this species of dynamometer is submitted. The aeronauts and voyagers in the car may always know during the ascension the excess of ascensional power of the balloon and the force with which the wind is acting on the cable.

A Source of Hard Times.

Speaking of the vast—and to a great extent avoidable—destruction of property by fire in this country, the *Fireman* says that fires are increasing, both in numbers and destructiveness, far more rapidly than the increase of wealth and production. It is computed that from an annual loss by fire in 1868 of $35,000,000, the annual loss, exclusive of exceptional fires such as Boston and Chicago (if they may be called "exceptional"), has increased to $100,000,000. The full significance of this statement cannot be realized unless analyzed. This loss is the irremediable loss of human product and industry. It is the conversion of human blood, brawn and muscle, necessary to create $100,000.000 of value, into ashes and smoke. Assuming the labor that produced this value to be worth $3 per day, this loss is the loss of more than the combined labor of 100,000 men for one entire year. Then, too, it must be remembered that this is surplus production. It has been accumulated by producers after earning livelihoods for themselves and families, and paying their share of the cost of government and their proportion of the burdens of society. It would require, then, the labor of 100,000 men for 20 years to replace by surplus production this annual loss. It is not only so much wealth subtracted from the resources of the country, but it is the loss of the productive power of so much capital.

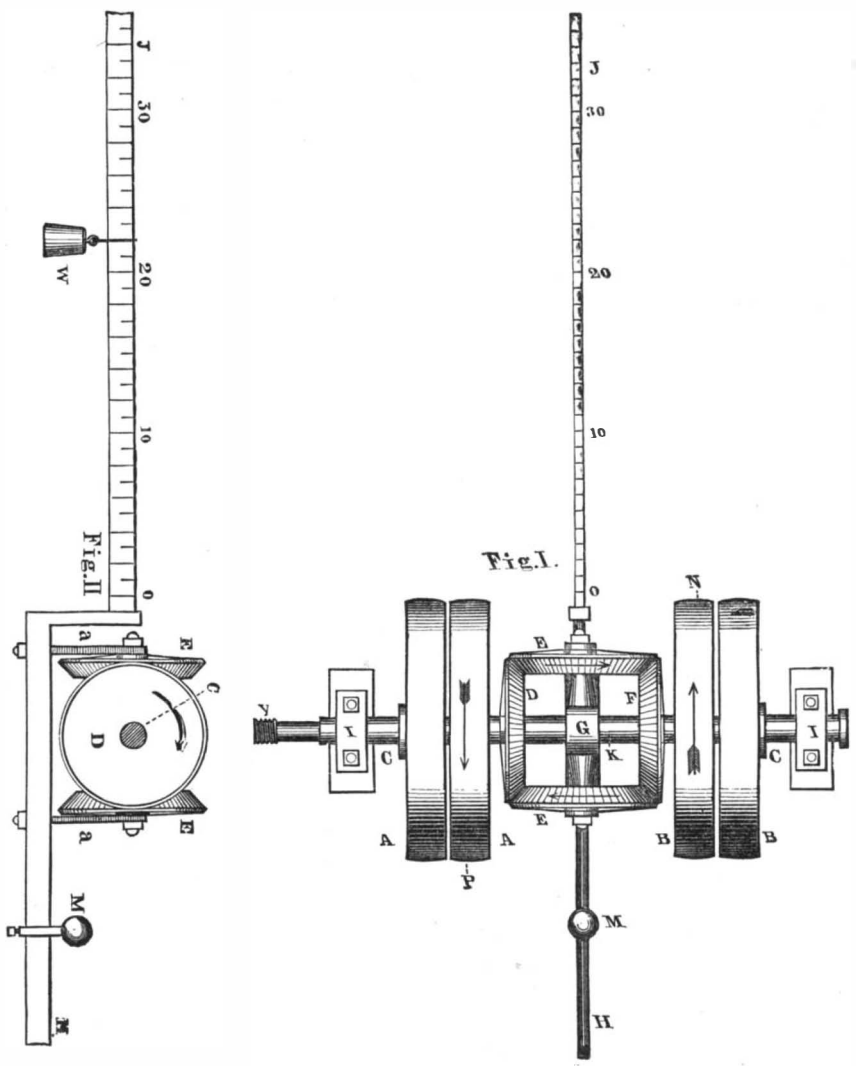
THE BALANCE DYNAMOMETER.

[*Continued from first page.*]

ber of pounds thus indicated multiplied by the number of feet through which the belt moves per minute will give the number of pounds raised one foot high per minute. The product divided by 33,000 gives the horse power expended in driving the machinery.

A worm, Y, on the end of the shaft, C, is made to move an index which shows the number of feet through which the belt or surface of the pulley moves in a given time.

In graduating the arm of the balance, J, the division marked 0 is the same distance from the center of the shaft as the periphery of the pulleys. The balance arm is divided into spaces equal in length to the semi-diameter of the pulleys, and they are marked 0, 10, 20, 30, and so on. The weight, W, will be double that of the strain on the belts. The plunger attached to the steel-yard and operating in the water box, as shown on the first page, was applied by Mr. James B. Francis, of Lowell, for preventing sudden vibration when the instrument is used in connection with machinery, when the strain is variable.



BATCHELDER'S BALANCE DYNAMOMETER.

This dynamometer has recently been used by Mr. Samuel Webber, of Manchester, N. H., for weighing the power of spinning and other machinery. A report relating to these tests is contained in his *Manual of Power*. The instrument is also used in connection with dynamo-electric machines by Professor John Trowbridge, of Cambridge.

A Veteran Inventor.

Mr. Samuel Batchelder, the inventor of the dynamometer described in this number, is a resident of Cambridge, Mass., and is now ninety-four years old. He has been engaged in the cotton manufacture for seventy years, having been owner, in part, at New Ipswich, New Hampshire, of the second cotton mill that was built in that State, about 1808.

This was previous to the use of power looms at Waltham, yarns only being made, which were woven into cloth upon hand looms, in farm houses; shirting, gingham, checks and ticking being thus manufactured. Pillow cases were also made without seam, the selvages being closed and the bottom woven in, forming a bag of the same kind as those now in extensive use for grain.

The Hamilton Mills, at Lowell, were built under the direction of Mr. Batchelder from 1825 to 1830 for the manufacture of twilled goods (jeans and drillings), which had not previously been made on power looms; he also built and managed the York Mills at Saco, Maine, from 1831 to 1846. Since that time he has acted as treasurer of the Portsmouth, the York, and the Everett Mills, the latter having been established by him at Lawrence, Mass., in 1860, and he continued in active business, making frequent visits from Boston to the mills, until he was eighty-six years of age.

He has made many improvements in the practical operations and machinery of the cotton manufacture, one of which was the "drawing frame stop motion," which was patented in England, and is now in general use in all cotton mills; also the use of steam for drying the sizing of the warps in dressing frames; the dyeing of cotton in the lap for mixed goods.

In 1863 he published a volume upon the "Early Progress of the Cotton Manufacture of the United States." His contributions to the newspapers in relation to the tariff, labor, manufactures and various other subjects of general interest are very numerous, and have been continued to the present time.

New Agricultural Inventions.

Mr. George W. Fawks, of Prairie Hill, Mo., has patented an improved Portable Hay Ricker for raising hay upon ricks. It is simple in construction, and is so constructed that it may be readily drawn from place to place, as required.

Mr. William H. Hall, of Tiffin, Ohio, has invented an improved wire toothed Hay Rake, which is lighter, stronger, more convenient, and less liable to break and get out of order than rakes constructed in the usual way.

An improved Grain Steamer and Drier has been patented by Mr. Fredrick A. Hoffmann, of Baldwin City, Kan. The object of this invention is to furnish, for the steaming and drying of grain and middlings, an improved apparatus by which the burrs may be supplied continuously with properly steamed and dried grain, without removing the apparatus, and without any choking of the same by the grains or middlings in their passage to the burrs. By using the apparatus, flour of a greater degree of whiteness and with a lighter bran is obtained, with less waste in the sweepings.

Mr. Charles E. Adamson, of Humboldt, Neb., has patented an improved Wagon Rack, which is so constructed that it may be readily adjusted to adapt the wagon for use for carrying wood, stone, lumber, corn in the ear or shelled, all kinds of grain, thrashed or unthrashed, small stock, hay, stalks, etc.

Mr. Leonard A. Cooper, of Winthrop, Mo., has patented an improved Corn Planter, Marker, and Cultivator, of simple construction, by which, in connection with the seed dropping devices, the rows are marked and the ground cleared of weeds.

An improved Stock Pump has been patented by Mr. Summit R. King, of Mason, Mich. The object of this invention is to furnish a mechanism which will enable the stock to pump water for themselves, thus rendering the use of a windmill or an attendant unnecessary.

New Article of Commerce.

A new and valuable member of the group of elastic gums is found in the sap of the bully tree, which flourishes on the banks of the Orinoco and the Amazon. It is called *balata*, and ranks between caoutchouc and gutta percha in useful qualities. It resembles gutta percha so closely in its general properties that much of it is shipped from Guiana and sold yearly for gutta percha—although it has many points of superiority. It is tasteless, gives an agreeable odor on being warmed, may be cut like gutta percha, is tough and leathery, is remarkably flexible, and far more elastic than gutta percha. It becomes soft, and may be joined piece to piece, like gutta percha, at about 120° Fah., but requires 270° Fah. before melting. It is completely soluble in benzole and carbon disulphide in the cold. Turpentine dissolves it with the application of heat, while it is only partially soluble in anhydrous alcohol and ether. It becomes strongly electrified by friction, and is a better insulator of heat and electricity than gutta percha. Caustic alkalies and concentrated hydrochloric acid do not attack it; but concentrated sulphuric and nitric acids attack it as they do gutta percha.

The Restoration of the Patent Office.

The committee of experts appointed by Secretary Schurz to select from the fifteen plans submitted for the remodeling of the portion of the Patent Office destroyed by fire has adopted the plan of Mr. Vrydagh, of Terre Haute, Indiana. The plan embraces the addition of an attic story. The upper portion of the building, which has been used as a museum for exhibition of models and curiosities, will be remodeled and made into office rooms, as more are necessary, and the new attic story will be used for a model room.

A Practical Resumption of Specie Payments.

To the Editor of the Scientific American:

It may interest your "hard money" readers to know that this Company, on its regular pay day, August 15, paid all its employees in gold coin.

YALE LOCK MANUFACTURING COMPANY.

Stamford, Conn.

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ASTRONOMICAL NOTES.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, August 31, 1878.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

	H.M.		H.M.
Venus rises	3 25 mo.	Saturn in meridian	1 31 mo.
Jupiter in meridian	9 21 eve.	Neptune rises	9 04 eve.
Saturn rises	7 34 eve.		

FIRST MAGNITUDE STARS, ETC.

	H.M.		H.M.
Alpheratz in meridian	1 25 mo.	Procyon rises	2 36 mo.
Mira (var.) rises	9 45 eve.	Regulus rises	4 40 mo.
Algol (var.) rises	7 11 eve.	Spica sets	8 02 eve.
7 stars (Pleiades) rise	9 31 eve.	Arcturus sets	11 42 eve.
Aldebaran rises	10 50 eve.	Antares sets	10 01 eve.
Capella rises	8 17 eve.	Vega in meridian	7 53 eve.
Rigel rises	1 01 mo.	Altair in meridian	9 04 eve.
Betelgeuse rises	0 46 mo.	Deneb in meridian	9 57 eve.
Sirius rises	3 02 mo.	Fomalhaut in meridian	0 14 mo.

REMARKS.

Saturn is rapidly increasing in brilliancy, and throughout the month of September will be the most brilliant and attractive body in the evening sky. A good 2½ or 3 inch telescope is necessary to exhibit well the charming and awe inspiring features of the Saturnian system. Such an instrument will show the three rings, the division between the outer and middle ones, the belts, four or five of the larger satellites, and the umbra and penumbra of the planet upon the rings. These last should be looked for only at or about the time of quadrature, and when the plane of the rings is most inclined to the earth's path. To observe the shadow of the rings upon the planet is far more difficult, but is most easily done when the planet is at or near quadrature, and the plane of the rings is not excessively inclined to the earth's path. With favorable atmospheric conditions during the latter part of September we think that the sixth and eighth satellites, Titan and Japetus, may be seen with a good opera glass. The middle ring is considerably brighter than the planet itself, while the interior one (Bond's dusky ring) is so transparent that the outline of the planet can be traced through it. The outer ring is of a grayish hue.

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although merely approximate, they are sufficiently accurate to enable the observer to find the planets.

M. M.

Position of Planets for September, 1878.

Mercury.

On September 1 Mercury rises at 6h. 57m. A.M., and sets at 6h. 43m. P.M. On September 30 Mercury rises at 4h. 33m. A.M., and sets at 5h. 10m. P.M.

Mercury may be seen in the morning in the latter half of the month; it rises before the sun and at a point north of the sunrise point. On the 25th Mercury is very near Venus.

Venus.

On September 1 Venus rises at 3h. 24m. A.M., and sets at 5h. 31m. P.M. On September 30 Venus rises at 4h. 33m. A.M., and sets at 5h 9m. P.M. the next day.

Venus will be small but brilliant all through the month.

Mars.

Mars is very distant, and its diurnal path lies very nearly with the sun; it will not be seen.

On September 1 Mars rises at 5h. 57m. A.M., and sets at 6h. 47m. P.M. On September 30 Mars rises at 5h. 38m. A.M., and sets at 5h. 34m. P.M.

Jupiter.

Jupiter is the most interesting planet at present. On September 1 Jupiter rises at 4h. 38m. P.M., and sets at 1h. 55m. A.M. of the next day. On September 30 Jupiter rises at 2h. 42m. P.M., and sets at 11h. 58m. P.M.

If we take the hour between 9 and 10 in the evening for observing Jupiter and its satellites, we shall find that the 1st satellite is invisible by being in Jupiter's shadow on the 1st and 24th of September; the same satellite is invisible at that hour, on the 8th and 15th, because it is behind Jupiter, and on the 18th, 23d, and 30th, because it is in transit across Jupiter's disk.

Taking the same hour for observing, the 2d or smallest satellite cannot be seen on September 2 because it is behind the planet, on the 11th because it is in transit across the planet, and on the 20th it may be seen coming out of the planet's shadow.

The 3d or largest satellite is invisible at this hour on the 10th, being in the shadow of Jupiter; it is invisible on the 17th because it is hidden by the body of the planet.

On September 9 the 4th satellite will not be seen during the evening; it is making its slow passage across the planet's face; a good telescope will show it like a white spot upon the planet.

Saturn.

On September 1 Saturn rises at 7h. 30m. P.M., and sets at 7h. 16m. A.M. of the next day. On September 30 Saturn rises at 5h. 31m. P.M., and sets at 5h. 11m. A.M. of the next day.

Saturn comes into its best position for observation in September; it rises so nearly in the east and is so steady in its light that it can be readily found. On September 12 Saturn is directly beneath the moon, and 7° distant, at midnight.

Uranus.

On September 1 Uranus rises at 4h. 45m. A.M., and sets at 6h. 12m. P.M. On September 30 Uranus rises at 3 A.M., and sets at 4h. 22m. P.M.

New Inventions.

Messrs. John H. Carrier, Barton R. Baker, and William McCarty, of London, Ky., have patented an improved Washing Machine, in which a revolving tub and reciprocating pounder are both operated simultaneously by belt and pulley mechanism.

Mr. José R. Villasana, of New York city, has patented an improved Cigarette Holder, by which the unrolling of the cigarette and the dropping of the same are prevented, and by which the cigarette may be placed on a table or desk without burning any part thereof, and it may be smoked while the hands may be used for other purposes.

An improved Sap Bucket has been patented by Mr. Albert E. Ware, of Hancock, N. H. The object of this invention is to so shape the corner pieces of sap bucket covers that they will serve the twofold purpose of a clasp and an emptying spout.

Mr. Ivy J. Hart, of Chandler, Ind., has patented an improved Wagon Jack, which consists in a novel construction, arrangement, and combination of a standard, a slide, and a lever, and certain details in connection therewith, whereby a jack is produced which is cheap, simple, strong, easily adjusted and operated, and occupies but a small space when not in use.

Mr. George Blatchford, of Mitchell, Ontario, Canada, has patented an improved Resonant Chamber for Organs. It will produce a more distinct and perfect vibration of the chamber, also a more solid and distinct volume of sound, and a more perfect control of the sound is secured, so as to produce a crescendo or diminuendo at will, and with less effort than in resonant chambers of ordinary construction.

Mr. Edward Row, of Indiana, Pa., has patented an improved Fire Escape, having rings or footholds, which may be made elongated, elliptical, triangular, or rectangular. The links for connecting the rings may be made of hoop iron or of round iron flattened at the ends.

Mr. Robert F. Roche, U.S.A., stationed at Fort Foote, Md., has patented an improved Adding Stick. The invention consists of a stick or ruler made in the shape of a polygon or cylinder in cross section, on the periphery of which numbers from zero upward are written consecutively in two spirals, whereby from certain movements of the thumb thereon in accordance with a known key, a column of figures may be accurately added without mental effort, and without danger of forgetting the aggregate amount of a portion of a column if attention should be called from the work.

Mr. Robert W. Tavener, of West Bay City, Mich., has patented an improved Measuring Faucet. This invention relates to an improved self-closing and liquid measuring faucet. The device consists of two parts, a transparent graduated measuring vessel, and a faucet proper, the two being so connected that liquid is received into said vessel through the faucet direct from the source of supply; and, the quantity being thus ascertained, it is discharged from the vessel back into the faucet, from which it escapes into any receptacle provided for it. The induction and exit orifice of the measuring vessel are one and the same. The faucet has two valves, which are so arranged that the orifice or passage through which the liquid enters and escapes from the measuring vessel is closed simultaneously with the opening of the discharge orifice in the faucet, and *vice versa*.

Mr. Charles H. White, of Danbury, Conn., has devised an improved Form for use in giving Shape to the Brims of Hats when the side parts of the said brims are turned or rolled, to enable the hats to be removed from the form without bending or warping their brims or changing their shape, so that the hats will set or stiffen with their brims in the exact shape given them by the form.

Mr. Nathan Scarritt, of Kansas City, Mo., is the inventor of an improved Horse or Rack for Airing Clothes after they have been ironed, and for drying clothes, which, when extended, will furnish a large amount of drying surface, which may be folded into small space for storage and transportation.

Mr. John Corbin, of New Harmony, Ind., is the inventor of a Machine for Drying Grain, Flour, Meal, Malt, Sugar, and similar articles by the use of steam. The invention consists of a revolving hollow center shaft having steam supply and exhaust pipes, in connection with a fixed hollow ring and hollow radial arms at one end of the shaft, and with a loose adjustable hollow ring applied by hollow arms and a sliding hub to the shaft. The loose ring is connected by flexible pipes with the center shaft, and the rings and arms are longitudinally connected by steam pipes jointed thereto, and finally inclosed by an outer cylindrical drum or jacket.

An improved Candlestick has been patented by Mr. William Yeung, of Easton, Pa. The object of this invention is to furnish a candlestick of simple and substantial construction, adapted to a chimney which will shield the candle from gusts of wind and prevent the flying off of sparks.

An improved Vehicle Spring Brace has been patented by Mr. Edwin R. Wheeler, of Merrimac, Mass. This invention relates to an improved device for hanging the body of carriages having a so-called "cut-under" or wheel house, such as a common rockaway, extension-top phaeton, coupé-rockaway, etc., so that one or more elliptic springs may be used, and the ordinary perch or platform gearings be dispensed with.

Mr. Walter F. Cranston, of West Middleburg, O., has patented an improved Coffee and Peanut Roaster for the use of dealers, farmers, and others, for roasting coffee and peanuts for retail or for private use, which will enable the coffee and peanuts to be roasted evenly and quickly, and prevent the smoke and odor from escaping into the room.

Mr. Joel Northrup, of Otisville, N. Y., has patented an improved Boot and Shoe. This invention consists in a tongue made of leather, elastic fabric, or other suitable material applied to a shoe or gaiter of any ordinary description, whereby provision is made for fastening the shoe in lieu of lacing it, for covering and protecting the joint where the edges of the shoe upper meet, and for allowing the shoe to yield and accommodate itself to the motion of the foot, so as to afford comfort to the wearer.

Mr. August Moll, of Brooklyn, N. Y., has patented an improved Star Braid. This invention relates to improvements in that kind of trimming braid known in the market as "star" braid, being mainly intended to simplify, facilitate, and cheapen the manufacture of star braid, so that it can more successfully compete with the imported article.

Messrs. Albert Whiting and Joseph A. Smith, of Rochester, N. Y., have patented an improved Machine for Raising Leather from Tan Vats. By means of this device the leather may be easily and quickly removed from the vats. It consists in the rack or false bottom, made in two parts or sections, hinged to each other at the center, to adapt it to be raised at the center into an angular position to raise and support the hides.

Horse Biscuits.

The Prussian military administration, after the close of the Franco-German war, established at great expense an experimental station at Nancy for the army of occupation, designed for making trials, technically and scientifically, in regard to foods which may be used by troops in a general way or under particularly difficult circumstances. The direction of the factory created with this intention was confided to M. Gustave Warnecke, of Frankfort-on-Main.

In the different manufactures and experiments that were made there, special attention was paid to the alimentation of horses, since these animals had been of such decisive importance in the different periods of the war of 1870–71.

After long and laborious gropings in the dark, Warnecke's "biscuits for horses" were finally produced. These, after a very severe trial on a large proportion of the horses belonging to the army of occupation, are admitted to be a great success. The "biscuit for horses," or, as it has been also called, the "oat comfit," consists of 30 parts of oat flour, 30 parts of "dextrinated" pea meal, 30 parts of rye flour, and 10 parts linseed meal; or, 40 parts of oat flour, 40 parts of dextrinated pea meal, and 20 parts of linseed meal; or, 20 parts of pea meal, 20 parts of wheat flour, 20 parts of corn meal, 20 parts of rye flour, 10 parts of grated bread, and 10 parts of linseed meal; or, finally, other analogous mixtures.

As the result of minute experiments it is stated that 4 pounds of these mixtures, well cooked, possess a nutritive value equal to that of a large ration of oats of about three times the weight. So the Prussian administration of the army of occupation, taking the results observed by the cavalry officers and the veterinary surgeons as a basis, admits that 3½ pounds of "oat comfits" are worth 12 pounds of oats. Experiments also demonstrated that horses fed on 12 pounds of oats did not support the fatigue to which they were submitted so well as those that received the 3½ pounds of comfits.

A result so brilliant, and one so favorable to the rapid movements of cavalry, could not remain ignored by other great military powers. The inventor, called to St. Petersburg, manufactured in that city, according to the above formulas, ten thousand rations of horse biscuits, which were submitted, in the cavalry and the Cossacks of the Guard, to experiments still more minute than those of the Prussian army. The horses were fed on the biscuits during twenty-six days (in Prussia ten days only); and every day notes were made of the state, plumpness, and weight of the horses, and their strength tested with the dynamometer. The superiority of the comfits over oats (a third of which are undigested and lost in the dung heap) was so marked that they were adopted, not only in imitation of Prussia, as an exceptional recourse for times of war, but also as a steady food in time of peace. The best recommendation that the new invention possesses is that the troops eat more of the biscuits than the horses. To put an end to this practice the Prussian administration was obliged to order five per cent of lupin flour to be mixed with the materials of the biscuit.

A ration is, as has already been stated, about 3½ pounds; it comprises from 25 to 30 biscuits of from 4 to 5 inches in diameter by four tenths of an inch in thickness. These biscuits, strung on wire, can be suspended to the saddle without danger of breakage, and a horse can thus easily carry nourishment enough to last him four or five days. They are given, either dry or wet (after having been broken up), at the rate of 7 in the morning, 12 at noon, and 7 in the evening.

American Institute Exhibition.

The interest evinced in the coming exhibition of the Institute is practically proven by the demand for space, and by the improved character of the exhibits offering. The managers state that the promise of a fine display never was better, and that although business is generally dull and the manufacturing industries are generally depressed, nevertheless the outlook is hopeful and encouraging. For all details address the General Superintendent, room 22, Cooper Union Building, New York.

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NEW OSCILLATING VALVE.

Our engraving represents a new form of oscillating valve for steam engines, the invention of Mr. Leonard Mangold, of Chattanooga, Tenn. The valve is shown in perspective in Fig. 1, in section in Fig. 2, and a detail of the valve packing is shown in Fig. 3.

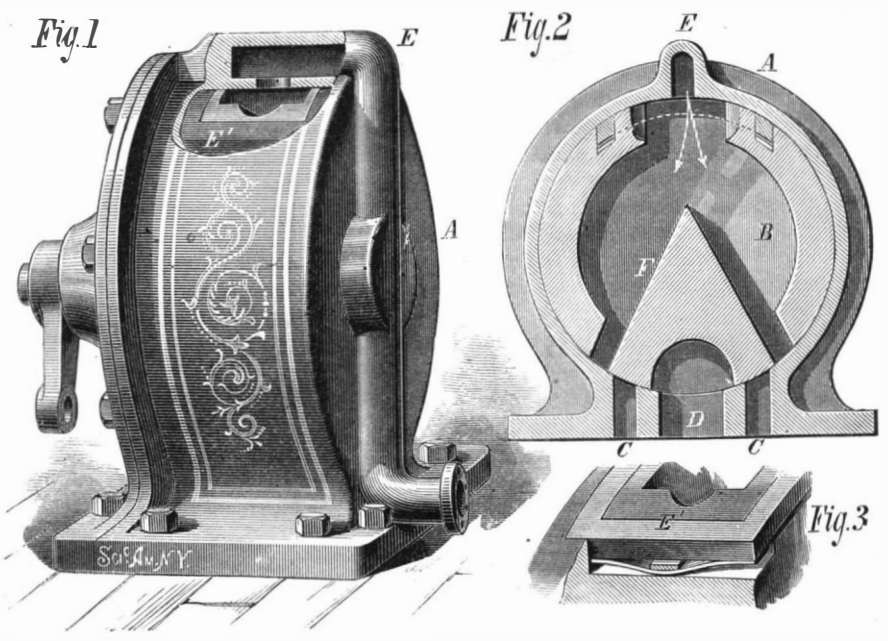
The valve casing, A, which is made in cylindrical form, contains a cylindrical valve, B, and has steam supply ports, C, and an exhaust port, D, between the two ports, C. A steam inlet, E, runs up one end of the case and enters the same at the top. The valve, B, has a steam inlet at the top, and at the bottom it has two outlet ports, one at each side of the triangular partition, F. This partition extends the entire length of the valve and upward above its center, and in its lower side there is a recess which forms a passage for the exhaust steam to the exhaust port, D.

Around the steam inlet port, in the top of the valve, there is a groove of suitable depth to receive a metal frame, E', which is curved to correspond with the curvature of the valve, and is forced outward by means of two springs placed under it in the groove. This frame forms a packing for the valve, and as it surrounds the inlet port it prevents the escape of steam in any direction.

The steam that enters the valve through the inlet port strikes the apex of the triangular partition, and is divided so that it will pass through either of the ports, C, with the same force, when the valve is turned so that one or the other of the ports, C, coincides with one of the outlet ports of the valve casing.

This valve is quite simple in its construction, and is said to be effective and not liable to get out of order.

For further information address the inventor as above.



MANGOLD'S NEW OSCILLATING VALVE.

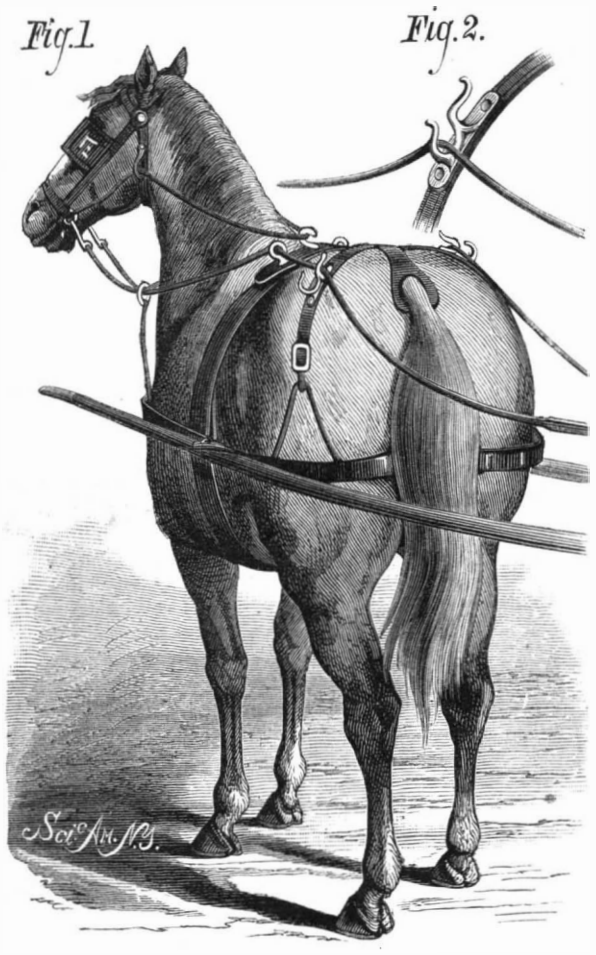
Value of a Waste Product.

For the past ten years the ammoniacal liquor produced at the gas works of Bradford, England, has been sold under contract for $4,000 a year. The holder of this contract lately bid $40,000 a year for a renewal of the contract, but failed, the successful competitor bidding $51,795. The discovery in the liquor of a substance useful in manufacturing aniline dyes was the cause of its enhanced value.

NEW REIN HOLDER.

This useful little device, which is shown so clearly in the engraving as to require little description, is the invention of Messrs. J. M. Taylor and J. Mackay, of Fredericton, N. B.

This rein holder consists of two double hooks, one of



TAYLOR & MACKAY'S REIN HOLDER.

which is attached to each of the hip straps. These hooks are placed about ten inches apart, and are equally distant from the back strap. The upper part of each hook is made quite open, so that the reins will readily drop into them when they are relaxed, and thus prevent them from becoming entangled with other portions of the harness, or getting brushed down by the horse's tail. The opening of the lower hook is smaller than that of the upper hook, so that when the reins are placed in the lower hooks by a dexterous movement of the hand, they will be retained securely. The reins are removed from the lower hooks by drawing them taut and at the same time moving them upward and outward.

This invention was recently patented in the United States and Canada. For further particulars address the inventors as above.

Iridescent Lace Work.

At the June meeting of the Society for Encouraging National Industry, of France, M. Hélouis exhibited samples of metallic threads and ribbons irisated by means of binoxide of lead, and also samples of lace work ornamented with them.

Nobili was the first to obtain such deposits as these on different metals, by electro-chemical means. He immersed a metallic plate, placed in communication with the positive pole of a battery, in a solution of acetate of lead, for example. The negative pole was fastened to a platinum wire, surrounded, except at the ends, by a glass tube; this tube dipping into the liquid in such a way that the free metallic end was placed at a distance of from 1 to 2 millimeters from the plate, the current was passed through it. It was observed that around the wire there were formed concentric rings, produced by delicate films of binoxide of lead, and characterized by varied and extremely brilliant colors, like those exhibited by soap bubbles. Becquerel made an exhaustive study of this phenomenon in 1843. By substituting for acetate of lead a solution of oxide of lead in potassa, or soda, he obtained iridescences that were much more solid, and by taking a certain number of wires as negative poles he was enabled to give objects of small dimensions uniform colorations of such tints as he wished. For certain kinds of objects his process is still in use at the present day.

But "irisation" has never before been attempted on ribbons or wires of such delicacy as to measure on an average 32,800 feet in length to the pound. M. Hélouis has succeeded in giving these delicate threads and bands uniform tints throughout their whole length, and in producing at will any color that he desires. With these irisated wires he ornaments laces, tissues, fringes, etc., which have a very beautiful effect, and the lace making industry is now making extensive use of them.

Pokeweed Paper.

Les Mondes says that Dr. Eugene Robert, of Segaune, France, has suggested that an advantageous utilization might be made of the common poke or pigeon berry (*Phytolacca decandra*) in the manufacture of paper. This common weed grows almost everywhere, is very hardy, and according to Dr. Robert yields an abundance of ligneous fiber extremely suitable for paper making. As the material is one that is so readily procured, it would be well for our manufacturers to try it.

A Tomato Disease.

M. Garcin has called the attention of the French Academy to a disease which has, during this year, attacked the tomatoes in the Maritime Alps. The malady made its appearance in the form of a whitish efflorescence on the surface of the fruit. Suspecting it to be due to the presence of a parasitic fungus, M. Garcin examined some of the matter with a high power of the microscope. It was seen to be composed of a mycelium of white, septate threads, finely granular at certain points; and the terminal joint of each of the ramifications was swollen and filled with spores. Free spores mingled with the mycelium; and the presence of zoospores of still larger dimensions showed the fungus to be in full fruit. M. Garcin believes, therefore, that he is correct in referring the parasite to the genus *botrytis*, several species of which are already well known. He calls attention to the fact that this season, for the first time in many years, the *muscardine* has made its appearance in many silk worm nurseries of the department. Now the *muscardine* is due solely to the development of *botrytis bassiana* in the body of the silk worm. Is there not, he asks, more than a fortuitous coincidence between this appearance of the *muscardine* and the epidemic development of the tomato disease? It is possible, he suggests, that sulphur applied in time, or sulphurous fumigations, would succeed in arresting the disease, since such means have always been successful in analogous cases, as in the oidium of the vine, peach mildew, etc.

THE NEEDHAM MUSICAL CABINET.

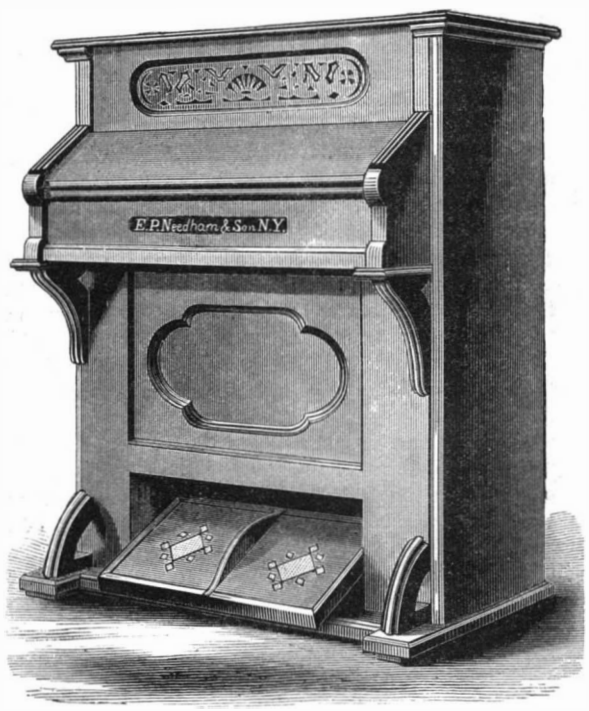
The accompanying engraving represents a musical invention which is perhaps one of the greatest novelties in this age of mechanical surprises. It is nothing less than a parlor organ on which any one can play the most difficult music, no matter whether he has a knowledge of music or not. All that is necessary is to put the music one desires to play inside the organ, and blow the bellows with the feet, when the music will be correctly executed; consequently any one, even a child, who has the ability of working the pedals of a sewing machine can produce all kinds of music as correctly as the most skilled professional performer, and it is done to such a degree of perfection that we may consider this instrument as a musical educator that may teach people in out-of-the-way localities the style in which various kinds of music have to be performed, whether vocal or instrumental, sacred or secular, operatic or classical.

The instrument always plays in correct time, and the most difficult passages are rendered as fluently as the more easy strains. The retardations and accelerations in time intended by the composer, and which are so beautifully observed by superior performers, are perfectly rendered on this instrument, entirely independent of the person working the pedals, who has only to keep in rotation a small fly wheel.

From the above it will be seen that to play this organ the use of the hands is dispensed with, and that the player may not have a musical ear; he may even be absolutely deaf and still execute the music perfectly.

All mechanical organs that have been built heretofore have been very complicated and expensive contrivances, on which only the pieces could be played for which the cylinders were arranged, while the length of the piece was limited. In the Needham musical cabinet, having the special sheets of music, any piece may be performed. And the way in which this is accomplished is beautiful for its simplicity.

The organ has neither keyboard nor valves, but consists of a set of bellows worked by the pedals, a set of reeds, to which the bellows furnish the wind, and a simple arrangement of mechanism which carries the music paper over the reeds. This music paper is the most essential feature of the



THE NEEDHAM MUSICAL CABINET.

instrument, and constitutes the artistic part of the same. The notes are holes punched in the paper, the length of the holes corresponding with the length of the notes, and when holes of the proper length are punched at proper distances, the paper, while passing over the reeds, will shut the wind off from some of the reeds while it permits others to sound. The pedals perform the double duty of blowing the bellows and carrying the music paper over the reeds.

The sheets of music paper, which are very strong, are 18 inches wide, and from 40 to 100 feet in length. Music sheets of this kind do not cost much more than ordinary sheet music, the perforations being made rapidly by means

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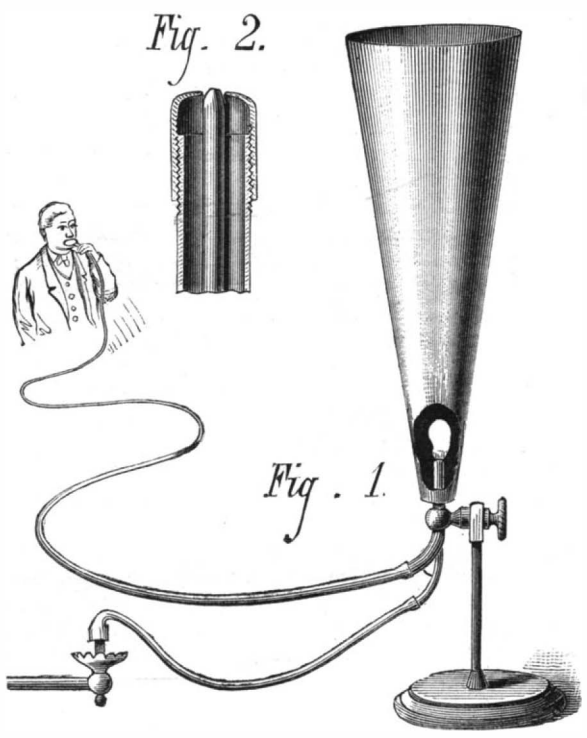
of special machinery. During the performance the music paper is unrolled from one cylinder and rolled upon another; and as music does not sound well when played backward, the mechanism is arranged so that while one piece is being played another is re-rolled.

Few persons are aware of the great number of notes in a musical composition; the number of holes in the music for this organ gives a striking illustration of this; for example, the music for the overture of "William Tell" contains 6,000 notes or holes. This is one of the 400 pieces contained in the present catalogue of Messrs. Needham & Son, and the number of pieces is being daily augmented.

THE SPEAKING FLAME.

BY GEO. M. HOPKINS.

During some of my recent experiments in acoustics, having occasion to investigate the characteristics of sonorous waves, I constructed a manometric flame apparatus after the plan of König, which, although it worked admirably and gave in the revolving mirror those well known and striking effects, did not possess the requisite qualities, although a very delicate diaphragm was employed; I therefore devised a peculiar form of annular burner, similar to those sometimes used in producing the oxyhydrogen light, but provided with an adjustable tip on the end of the outer tube, as shown in Fig. 2.



THE SPEAKING FLAME.

After connecting a mouthpiece with the outer tube, by means of a piece of rubber tubing, and connecting the inner tube with a gas burner in the same way, by making sound in the mouthpiece I succeeded in producing in the rotating mirror the clear, sharp-cut flames shown in Fig. 5, which were entirely satisfactory, and which will be treated further on.

In testing this apparatus I observed that the burner emitted low tones, like those made in the mouthpiece. By carefully adjusting the cap to the outer tube of the burner I succeeded, without a great deal of trouble, in getting the flame to reproduce distinctly any tone made in the mouthpiece. These tones were evidently produced by the minute and rapid explosions of the gas as it was relit after being extinguished by the round waves emerging from the annular orifice of the burner. This flame should not be confounded with the well known singing flames, as they each have an individual tone, whereas this flame will produce any note in the scale.

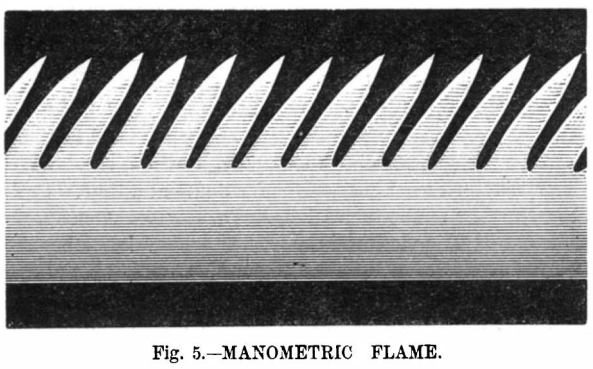
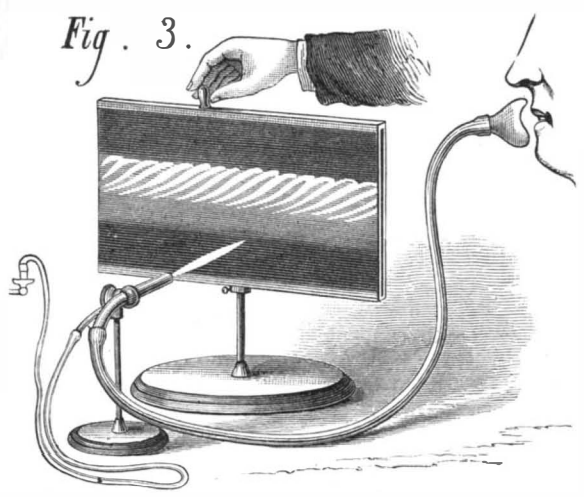


Fig. 5.—MANOMETRIC FLAME.

While sounds can be clearly heard without a resonator of any kind, yet they can be greatly re-enforced by applying a long funnel to the burner, as shown in Fig. 1. After having nicely adjusted the burner, I was greatly surprised to hear the flame reproduce a melody as loudly, clearly, and beautifully as the singing telephone, and with the characteristics of the singer's voice plainly distinguishable; but what was my astonishment when the flame made articulate sounds as words were spoken into the mouthpiece. Scarcely believing my own ears, I placed between the burner and mouthpiece thirteen feet of rubber tubing, and carried the tube through two walls, so that none of the sounds could possibly be heard from the mouthpiece; still the flame talked in an intelligible way. By a preconcerted signal I was most happily assured that at least three fourths of the sentences uttered in the mouthpiece and reproduced by the flame were understood.

To determine whether the articulation was wholly due to the flame, the gas was turned off, but no sounds from the



MANOMETRIC FLAME APPARATUS.

mouthpiece could be heard at the orifice of the burner. On relighting the gas, sounds were produced as before. The flame has a peculiar appearance when singing or talking; its ghastly blue and its weird sounds are suggestive of the supernatural.

Since discovering the sound-producing capabilities of the flame, I have observed many peculiarities, and some difficulties to be surmounted. All of the breath used in producing the sounds must enter the mouthpiece and be propelled through the tube and burner. An explosive sound at first extinguished the flame entirely; but a short slit cut in the rubber tube near the mouthpiece afforded an escape for the overpressure, so that a word beginning with an aspirate or a consonant could be pronounced without extinguishing the flame. Much depends on the direction of the wind as it escapes from the annular orifice. It should pass from all sides diagonally across the tip of the inner tube or gas burner.

When this burner is employed in producing manometric flames, the ordinary two-sided revolving mirror, shown in Fig. 3, is used. When it is revolved behind the burner, as shown in the engraving, it may be made to exhibit all of the phenomena of König's apparatus, and in addition to this some effects may be produced which are peculiar to this apparatus. Defects in the vocal organs show themselves in the character of the flame. While a clear voice or a musical instrument will produce the clear-cut flames shown in Fig. 5, a hoarse voice will produce a small extra flame between the bases of the others, and a "husky" or dry voice will produce a fuzziness at the sides and point of the flame. A trill, made by saying *t-r-r-r-r* in a high key in the mouthpiece, produces a flame which, in the revolving mirror, appears like that shown in Fig. 6, and by inclining the burner at a proper angle a figure will be produced which resembles a golden rope (Fig. 7) whose strands are fine or coarse as the pitch of the sound is high or low. In addition to these most beautiful flame figures, the waves (Fig. 8) are produced by making a loud tone of low pitch in the mouthpiece. The waves, which are fire tipped, are of a gorgeous blue, as is also the band from which they rise.

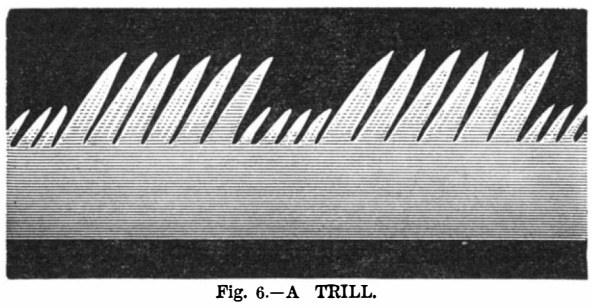


Fig. 6.—A TRILL.

A beautiful effect is secured by using the mirror shown in Fig. 4, which is simply a disk mounted on a small shaft, and arranged at a slight angle with the plane of rotation of the shaft, so that when it is turned it will "wabble" and produce a blue crown with golden tipped flames. By connecting the burner with a flute, as in the illustration, very sharp and clearly defined flame points will be formed.

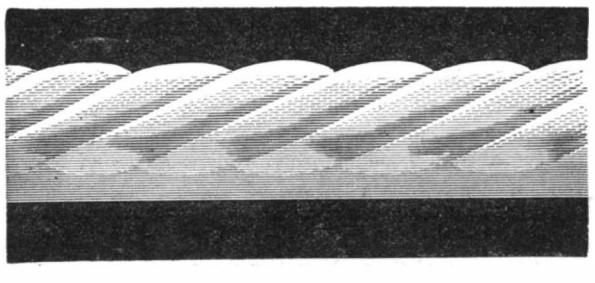
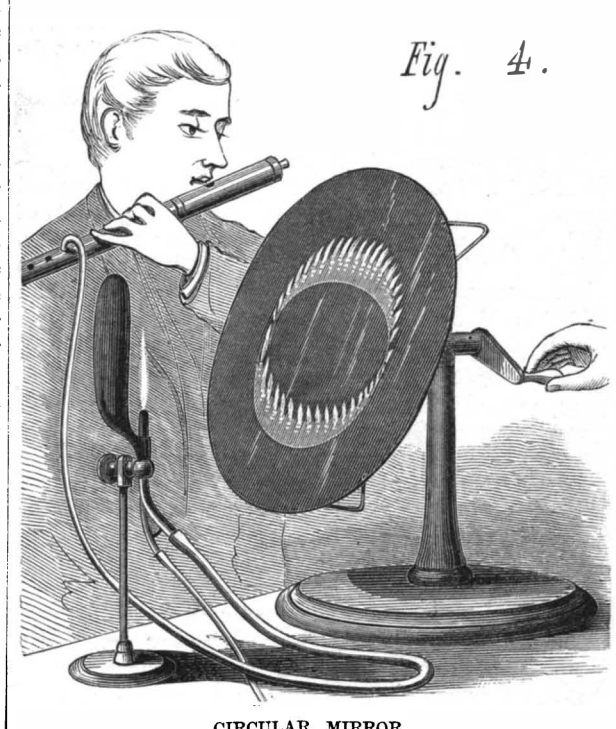


Fig. 7.—A GOLDEN ROPE.

In all of these experiments the band from which the flames spring, as well as more or less of the base of the flame, is of a beautiful indescribable blue.

The Silk Thread Electroscope.

To the Société des Sciences of Nancy, M. Rameaux recently introduced a very simple and sensitive electroscope. It consists of a fine fiber of white silk, fixed at one end by means of a little wax to any support, and free to oscillate in any direction under its point of attachment. A single thread would, of course, suffice for the ordinary purposes of electroscopy properly so called, but it is preferable to employ two near each other, taking care to space them so that they cannot foul each other during their swing, or influence each other reciprocally. One of the threads is charged by means of a glass rod with positive electricity. The other is charged by means of a stick of resin with negative electricity. Every body which attracts one of the threads so charged, and repels the other, is necessarily electrified. Its electricity is of the same sign as that of the thread which it repels. The sensibility of these electroscopes is greater, within certain limits, as the threads are made finer, longer, and less conducting. If the finest sewing silk of commerce be untwisted, each of the parts or strands obtained will make an excellent electroscopic pendulum, which, if about 2 feet long, is very handy, and suffices for almost all tests. White silk is preferable to colored. The motions of these threads, if well charged, are considerable, even when the bodies presented to them contain but slight charges of electricity. When the threads are not excessively fine, disturbances of the air do not destroy the observations so much as might be



CIRCULAR MIRROR.

supposed. M. Rameaux has found this arrangement in all cases more sensitive and sure than a carefully constructed gold leaf electroscope which he used for comparison. This system also recommends itself in several ways; for instance: 1. It is so simple that every one can construct and use it. 2. It costs nothing, no special support being necessary. The threads can be fixed to any projecting piece, as the edge of a table, the only condition being that they may hang freely. 3. It can be set up in a moment, and consequently is at once ready for any unexpected requirement; whereas a gold leaf electroscope long unused requires to be dried for hours. 4. It works perfectly, whatever the hygrometric state of the atmosphere. 5. It can be employed to show electric phenomena to a numerous auditory. With long thin fibers and highly electrified bodies the experiments are very telling.

Effect of Glycerine on Fermentation.

It is well for those who manufacture articles liable to decomposition to know that glycerine has the power of arresting fermentation to a remarkable degree. It is stated in the *Chemical Journal* that glycerine retards both lactic and alcoholic fermentations. One fifth of glycerine added to milk at a temperature of 15° to 20° C. prevents it from turning sour for eight or ten days. One half or one third of glycerine, at the same temperature, retarded the fermentation of milk for six or seven weeks.

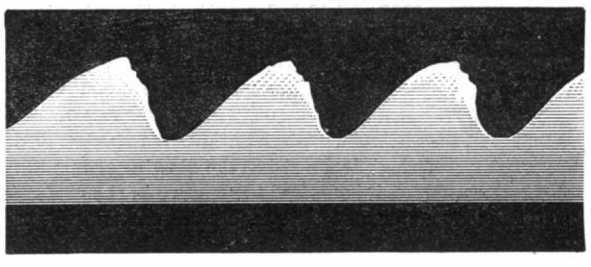


Fig. 8.—WAVES.

At higher temperatures larger quantities are needed to produce the same results. The formation of hydrocyanic acid from amygdalin and emulsin is also retarded by glycerine. It becomes thus very serviceable in preventing the spoiling of various lotions. For this reason it is not unusual to add a small quantity to the preparation known as milk of roses, and also to almond paste. With regard to cosmetics generally, the use of glycerine in small quantities may be recommended.

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New Decorative Processes.

Electrotyping.—*La Nature* states that some specimens of metal work now on exhibition in the halls of the Academy are being greatly admired, and are mistaken by every one for silver, until the secretary explains that this effect has been obtained by M. Gaiffe in depositing a coating of cobalt on red copper by means of a battery It would seem as if this new conquest of electroplating might be applied to en graving; and to show that it may be, the author sends two proofs, one taken from an ordinary copper plate, and the other from the same plate "cobalted." The advantage of this process lies, first, in the durability of the cobalt, which allows of a great number of impressions, and, secondly, in the fact that the plate being exhausted, nothing is easier than to remove the cobalt without harming the copper, and then to cover it again with a new coating. Nickel, which is so readily applied to metals, will not admit of such a manipulation.

Decoration of Zinc.—Dr. L. Stille has recently described a chemical process for covering zinc with colored coatings. The articles of zinc are first brightened by scouring with quartz sand, moistening with dilute muriatic acid, putting them quickly in water, and then wiping them dry most carefully with white blotting paper. To insure success, however, it is necessary to employ zinc as free as possible from lead, and to have it bright like a mirror. When these conditions are fulfilled the metal may be coated with a variety of beautiful colors by immersion in a solution of alkaline tartrate of copper for a shorter or longer time, depending on the color desired.

Coloration of Metals.—The *Industrie Progressive* is responsible for the following statement: Metals may be rapidly colored by covering their surfaces with a thin layer of sulphuric acid. According to the thickness of the layer and the duration of its action, there may be obtained tints of gold, copper, carmine, chestnut brown, clear aniline blue, and reddish white. These tints are all brilliant, and if care be taken to scour the metallic objects before treating them with the acid, the coloring will suffer nothing from the polishing. On making a solution of 640 grains of lead acetate in 3,450 grains of water, and warming the mixture to 88° or 90°, it decomposes and gives a precipitate of sulphuret of lead in black flakes. If a metallic object be immersed in the bath, the precipitate is deposited upon it, and the color produced will depend on the thickness of the deposit. Care must be taken to warm the objects to be treated gradually, so that the coloration may be uniform. Iron treated in this way has the aspect of bluish steel; zinc, on the contrary, becomes brown. On using an equal quantity of sulphuric acid, instead of the lead acetate, and warming a little more than in the first case, common bronze may be colored of a magnificent red or green, which is very durable. Very beautiful imitations of marble may be obtained by covering the bronze objects, warmed up to 100°, with a solution of lead thickened with gum tragacanth, and afterward submitting them to the action of the precipitate spoken of above.

Gas Cloth.—"Gastuch," or gas cloth, is a name given by Dr. Hirzel, of Leipsic, to a gas and water tight stuff which he has recently patented. This is produced by placing a large smooth piece of so-called gutta-percha paper between two pieces of some not too coarse and dense material —*e. g.*, shirting (undressed)—and then passing the arrangement between heated rollers. The outer pieces of the shirting combine in the most intimate way with the inclosed gutta-percha to form a material which is impenetrable by gas and water. It may be made still denser and more resistant by being coated on both sides with copal lac, for instance. The material is said to be well adapted to form gas-tight membranes for regulators of pressure, of compressed gas bags, or sacks for dry gas meters, as also dry gas reservoirs.

Iridescent Glass.—This beautiful product, which has been so successful, and the demand for which is still increasing, is now made, according to the *Revue Industrielle*, by burning chloride of tin in the furnace. There are thus produced fumes for which warm glass has great affinity, and which immediately produce an iridescent surface upon it. To heighten the tints a small quantity of the nitrates of baryta and strontia may be used. The irisation is completed during the working of the piece—either the blowing or moulding. Those pieces which it is desired to preserve in the perfection of iridescence are never placed in the furnace a second time.

Application of Galvano-plastic to Glass Decoration, by M. Alexandre (in *Moniteur de la Céramique*).—The process rests on the application of electro-metallurgy to the decoration of glassware, mirrors, etc., either for the exterior or interior decoration of houses, furniture, etc. The substance which serves for tracing the design on the glass is a metallic paste of good conducting power, mixed with a solvent and thinned with an essential oil. The design once executed on the glass, the latter is submitted to the action of fire in either a muffle or a furnace, and is not withdrawn until perfectly cold.

The glass is then immersed in a metallic bath and a galvanic current passed over it; by this means the metal in suspension in the bath is precipitated on the design. The glass is withdrawn as soon as the coating becomes as thick as required. Finally, if necessary, the metallic design is finished up by chiseling or other means, and is left thus; or, indeed, another layer of a like or different metal may be deposited on it.

Recent Contributions to the Germ Theory of Disease.

Among the important facts, says *Les Mondes*, that have been brought to notice in the medical world within the last three months, one of the most remarkable, without doubt, is the communication made to the Academy of Medicine by M. Pasteur, at the session of April 23. At this date, M. Pasteur made known to the Academy that there is a vibrio capable of producing septicæmia, just as bacteria produces carbuncle. He made known at the same time the conditions under which this vibrio exists, as well as the cause of its death.

The vibrio of septicæmia is killed by oxygen and pure air, but develops and multiplies in a medium of carbonic acid. Since air and oxygen kill the vibrio of septicæmia, it would seem that it ought never to follow in the train of wounds, for all wounds are always more or less in contact with the air, which is a deleterious element for these little organisms. But by dint of ingenious investigations, M. Pasteur has discovered that under certain determined conditions the vibrio can live and multiply in spite of its apparent contact with the air. Besides the vibrio of septicæmia, M. Pasteur announces that he has detected two others—one presenting nothing of interest to medicine, seeing that it is incapable of supporting the mean temperature of living man; the other, which accommodates itself very well to the temperature of the human body, is that which gives rise to purulent infection.

So, then, carbuncle, septicæmia, and purulent infection would be due to germs having characters perfectly distinct; and according as these germs are mixed in such or such proportion, we would obtain such or such infection. These views are not merely theoretical, but are confirmed by experiments which appear pretty convincing; for, according as he inoculates the germ of such or such a one of these maladies, M. Pasteur produces at will carbuncle, putrid infection, or purulent infection; and in mixing these different germs together he obtains an affection a little different from the three others, but which comes nearest to that which has furnished the most infecting germs.

This important communication from M. Pasteur was followed at the succeeding session of the Academy by a remarkable paper from M. Alphonse Guérin, on the different theories of purulent infection, and the means of remedying them. Space does not allow us to enter into the details of this able paper, but we can merely say that for M. Guérin, as for M. Pasteur, purulent infection is the product of germs. In aid of this opinion, M. Guérin cited the results of a long practice in the treatment of wounds—results which, gained by a method of treatment of his own, were extremely successful, and added another strong argument in favor of the theory of production of purulent infection by microscopic germs.

Theoretical Reformers.

Speaking of the swarm of confident but ill-informed theorizers who presumed to represent the workingmen of the country before the Congressional Committee for investigating the "labor question," in session in this city, the *Tribune* sarcastically, yet not unjustifiably, remarks that "it is a curious circumstance that the men who do not own a dollar of capital, and never, except upon compulsion, do a day's work at any kind of labor, are the ones who understand better than anybody else the relations of capital and labor, and are the most competent to adjust each to the other and to the State. Curiously enough, too, the men who own capital and the men who live by labor are so ignorant of the whole subject that they cannot be permitted to arrange their own business. The capitalist cannot negotiate with the workingman for the labor which makes capital productive, nor the workingman treat with the capitalist for the exchange of his labor for pecuniary reward, without the interference of other men who not only do not labor nor employ labor, but who have never studied this or any other question, and have hardly reflected soberly upon its most superficial aspects. And these latter are the ones who speak with authority."

It is a pity that so many political newspapers and politicians mistake the vaporings of such idle theorizers for the views of workingmen. Our sober-minded and practical artisans and mechanics—and they constitute numerically as well as industrially the real working class—are not given to such crack-brained schemes for inaugurating the millennium by government proclamation.

Printing in Japan.

The advantages possessed by the art of printing with movable types are incontestable. For Europeans, whose alphabet is composed of a small number of letters only, nothing is more easy than to form words. But it is a different thing entirely in countries which, like China and Japan, have a particular character to express every idea—every word. According to the correspondent of a journal from which we borrow these details, the complete collection of Japanese types comprises 5,000 characters, of which 3,000 are in constant use, and 2,000 are employed occasionally. These types are arranged in a Japanese composing room on shelves like the books in a library; the compositor is thus obliged to be continually on the go while collecting his types. The great number of their characters for printing has thus far prevented the Chinese and Japanese from corresponding by electricity; the telegraph, that instrument of civilization, having remained in the hands of foreigners. It is no wonder then that the telephone has been received in Japan with the greatest favor.—*Le Monde de la Science.*

An Interesting Discovery.

According to the Denver (Col.) *News*, Professor Snow, of the Kansas University Scientific Expedition, has lately made a most interesting "find," in Gove county, about three hundred miles east of Denver.

This discovery consisted of a giant reptile, or Saurian, so perfectly preserved as to exhibit a portion of the outer covering. Previously geologists had found hundreds of specimens of these Saurians with the bones alone remaining, so that this discovery of the outer skin is something entirely new to science. The Saurian in question was about thirty feet in length, and it might have been supposed that the external plates or scales would be of large size, as is the case with the living crocodiles and alligators. But, on the contrary, the Saurian scales are very small for an animal of such imposing dimensions, being no larger than those of an ordinary garter snake. The rock in which this fossil was found was of the cretaceous formation, unusually compact in texture, which probably accounts for the preservation of so perishable a portion. In order to reach the specimen it was necessary to remove about six feet of overlying rock, which required three days' labor of the Professor and his two assistants. In other respects the expedition has been very successful, having already shipped to Lawrence, for the university cabinets, upward of one hundred fossil fishes and many Saurian skeletons, besides six or seven thousand specimens of the living birds, plants, and insects characteristic of the plains.

New Mechanical Inventions.

Mr. Hulbert N. McConoughey, of Grant, Iowa, has patented an improved Attachment for any ordinary Seed Planter, for planting the seed in accurate check row by means of a smooth rope.

Mr Arthur R. Steel, of Letts, Iowa, has patented an improved Motor for running light machinery, such as churns, sewing machines, lathes, etc. It may be run by weight or lever at any desired speed, and conveniently rewound.

An improved Knife for Cutter Heads has been patented by Mr. Patrick C. McGrath, of Plattsburg, N. Y. The object of this invention is to furnish an improved manner of making planer knives and of securing them in place upon the cutter heads, which will enable the knives to be held firmly and securely in place, and readily set in or out, as desired, and which, at the same time, will enable the knives, when worn or broken, to be replaced at a comparatively small expense.

Mr. William T. Elliott, of Orange, Mass., has patented an improved Sewing Machine Shuttle, which is so constructed that the bobbin may be readily put in and taken out, and it will hold the bobbin securely, and will enable any desired tension to be given to the thread.

Chemical Analysis of the Sundew.

The sundew (*Drosera rotundifolia*), which has been made conspicuous, among the insectivorous plants, by the minute study bestowed on it by Darwin and other observers, has recently been analyzed by G. Lugan. The fresh plant was treated by the process know as dietheralysis. The author states (*Journal de Pharm. et de Chim.*) that the aqueous liquid obtained thereby contained glucose, various salts, and a crystallizable organic acid apparently peculiar to this plant; this was also obtained from the ethereal liquid by evaporating it and treating the residue with chloroform, which leaves it undissolved, along with wax and yellow coloring matter. On evaporating the chloroform, a greenish-brown resin was left, which had a strong and characteristic odor, was exceedingly acrid, and produced a burning sensation when applied to the skin. The author found the viscid exudation of the glandular hairs to be destitute of acid reaction, and was unable to obtain formic acid, which has been stated to be the principle by means of which the leaves convert albuminoid matters into peptones.

Poisoning by Peach Stones.

A fatal case of poisoning by peach stones, which is noted in the French papers as having recently occurred in Paris, should serve as a warning to families in which children are allowed to look after themselves for hours at a time. Probably very few adults themselves know how poisonous peach stones are. The victim of the recent accident in Paris secreted the stones of a number of peaches, and, obtaining a hammer, when left alone broke them open industriously and ate them; the result being that he was fatally poisoned by hydrocyanic (prussic) acid. Since the peach season is now upon us, it is as well to explain what quantity of poison the peach stone possesses. Writers on toxicology state that one ounce of the kernels contain about one grain of pure prussic acid, and this quantity, it is well known, is sufficient to kill any adult person. Even two thirds of a grain has very often proved fatal, and indeed may well be regarded as a fatal dose for any child.

The Population of the Earth.

The fifth publication of Behm and Wagner's well known "Population of the Earth," makes the number of the earth's human inhabitants for the current year 1,439,145,300, an increase of fifteen millions over the estimate of last year. The increase is attributed partly to natural growth, partly to exacter knowledge due to recent censuses. The distribution of the population among the grand geographical divisions is as follows: Europe, 312,398,480; Asia, 831,000,000; Africa, 205,219,500; Australia and Polynesia, 4,411,300; America, 86,116,000.

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THE MESQUITE.

An industry that promises, perhaps, to be of considerable importance has recently sprung up in the West. The mesquite, a common tree of the deserts, and closely allied, botanically, to the acacia, yields, like the latter, a gum which closely resembles and in fact is almost identical with gum acacia (the gum arabic of commerce). This gum was brought to notice as long ago as 1854, by Dr. Shumard, of the United States army. It has for some time been kept in the drug stores of the Mexican cities, and considerable quantities have been sent to San Francisco from the Mexican ports of the Pacific. During the past year it has become an article of export, some 12,000 lbs. having been gathered in Bexar county, Texas, and as much more between that and the coast.

The mesquite (or, as it is sometimes called, mosquit) is the Mexican name for a leguminous tree belonging, like the gum arabic producing acacia, to the suborder *Mimosa*. It is a tree growing from 30 to 40 feet in height, with a rounded head. It bears, in its general aspect, a great resemblance to the common honey locust (*Gleditschia*); its leaves are twice-pinnate, and the leaflets narrow, somewhat curved, and an inch or more in length; the flowers are small, greenish-yellow, and crowded in dense axillary spikes; the pod or bean is from 6 to 9 inches in length, curved or straight, flattened, and constricted between the seeds.

There are several species of mesquite, but the one under consideration (*Prosopis glandulosa* of botanists) has the widest range, being found as far north as the Canada river, and extending south into Mexico; it appears in Texas not far from the coast, and is the most abundant tree as far west as the Colorado and Gulf of California. Were it not for the presence of the mesquite, immense tracts in Arizona and Northern Mexico would present greater difficulties to travelers than they do, since this tree affords the sole fuel and forage of the country. As fuel, the wood has no superior; it makes a fire almost as intense as one of anthracite. The pods or beans, which ripen in June, contain a sugary pulp having an agreeable blending of sweetness and acidity, somewhat like the harvest apple. They are very nutritious, and while their importance to the civilized traveler lies in their value as food for horses in districts destitute of grass, they are of still greater importance as articles of food to the Indians living within its reach. To whites the taste of the fruit is somewhat mawkish and unpleasant, but it is greatly relished by the Mexicans and Indians. The latter, when the pods are in a fresh ripe state, put them into a wooden or stone mortar and bruise them, then mix them with water and empty them into an earthen dish, where, after standing a few hours, there results a sort of cold porridge or mush. All present then collect around the newly prepared mess, and, sitting on the ground near the dish, scoop the food out with their hands without any ceremony, and without regard to distinction of rank, age, or sex. The nearly naked bodies of the Indians soon become smeared with the food from head to foot, and the shaggy appearance of their hair adds nothing to their aspect of cleanliness. The meal finished, their faces assume a complaisant look, while their tumid abdomens give abundant evidence of the quantity of food consumed.

The pods, as they ripen, are gathered for winter use; and, after being thoroughly dried, are stowed in cylindrical-shaped baskets, made of twigs, and covered with mud and grass to keep out rain. In this shape they can be preserved for a long time. They are among the great luxuries of the Apaches, Pimas, Yumas. Maricopas, Mohaves, Hualipais, Cocopahs, and Moquis, of Arizona, besides of many tribes in New Mexico, Utah, Nevada, and the southern portion of California. The squaws pound the dried pods until reduced to a fine powder, which, being mixed with a little water, is pressed into large thick cakes weighing several pounds, and these being dried in the sun are afterward used as circumstances require. The pods are also often kept in the powdered state in bags; but if the beans are not pulverized as fine as the pulp they soon become a living mass, since from every bean will issue a weevil, a species of *bruchus*. To the Indians, however, this is a matter of indifference; and they never trouble themselves to pick the insects out, but allow them to become an ingredient of the bread. If reduced to a fine flour the insect larva becomes a part, forming a homogeneous mass of animal and vegetable substance. The flour being very sweet, forms, when mixed with water, an agreeable drink; boiled in water and fermented, there results a pleasant and nutritious beverage, held in great esteem by the natives. The bark of the tree is utilized by the Indian women for making skirts, and it is also twisted into ropes or twine, and even woven into baskets.

The gum which exudes spontaneously from the bark of the tree is described as very similar in its properties to gum arabic, and an analysis by Dr. Morfit has shown that in composition and chemical properties it very closely resembles the latter. As it oozes from the bark it concretes into tears and lumps of various sizes, which vary in color from pale yellow to dark amber. It is very brittle, easy to pulverize, and its fractured surfaces are brilliant.

The natural exudations from a single tree vary from an ounce to three pounds, but doubtless much more would be yielded were incisions made in the bark. The branches are said to furnish a purer quality than the trunk. The gum, when perforated by insects, is often eaten by the Indians. All the tribes of Arizona mix this exudation with mud, which is then daubed over the head, thus serving two purposes—killing parasites, and rendering the hair dark and glossy. As the mesquite trees abound upon the plains over regions thousands of miles in extent, and flourish luxuriantly in dry and elevated situations, the gum must, in course of time, become an important commercial article when the facilities for gathering it become more perfect.

THE MESQUITE.

The Law in Respect to Small Steamboats.

In view of the large number of small steamboats and launches now in use throughout the country, the following information respecting the requirements of the law concerning their construction, engineering, etc., will doubtless prove useful. This information has been furnished by the Supervising Inspector General of Steamboats of the Treasury Department, Washington, and is from a decision made by the Department, July 3, 1875:

Under section 4,426, Revised Statutes, the hull and boiler of every yacht, or other small craft of like character propelled by steam, must be inspected—the boiler being subjected to the hydrostatic test required by law. The pilot and engineer must also be licensed; and such other provisions of the law complied with as may be applicable to the particular vessel under examination.

Sections 4,428 and 4,431 require that the iron or steel plates of which the boiler is constructed must be stamped with the name of the manufacturer, the place where manufactured, and the number of pounds tensile strain it will bear to the sectional square inch.

The boiler must be provided with such appurtenances as are necessary to its safe management, namely: Feed pump and check valve, steam pressure gauge, safety valve, gauge cocks, a water gauge (showing the height of the water in the boiler), and blow off valve; and, if it is found applicable to the kind of boiler employed, a tin plug, so inserted that it will fuse by the heat of the fire when the water in the boiler falls below the prescribed limit.

There must be on board the means of applying the required hydrostatic test.

For so small a vessel as you describe (26 feet long), four buckets kept on board will be sufficient means for the extinguishment of fire.

There must be provided for each person on board a life preserver containing at least six pounds of good block cork, adjustable to the body in the manner of a belt or jacket, with shoulder straps.

The fee for license as "special engineer" for this yacht, which will be granted to any person of good character, who has sufficient experience to manage the boiler and machinery safely, is five dollars. A similar "special license" as pilot for this vessel will be granted to any person of like good character who is familiar with the navigation in which she is to be employed, understands the pilot rules, and has had sufficient experience in handling this or other similar vessels.

The master of a vessel of this class does not require license.

A steam whistle of suitable dimensions must be provided, with which the pilot will make the signals as required by the pilot rules above referred to.

When the equipment is completed and the vessel is ready for inspection, it is required that application shall be made in writing by the master or owner to the local inspectors within whose district the vessel is owned or employed.

New Engineering Inventions.

Mr. George W. Dixon, of Spring Lake, Mich., is the inventor of an improved Valve Movement for Direct-acting Steam Pumps, by which the noisy tappets and the expense for the same are dispensed with, and a smooth, positive, and reliable motion is given to the valve. The valve will always move with perfect accuracy, and dispense with an auxiliary valve.

An improved Packing for Oil Well Casings has been patented by Mr. John Q. Miller, of Emlenton, Pa. This is a packing for the casing of oil wells at that point where the oil well is continued downwardly at a less diameter than in the upper part of the well hole, the packing being so arranged that the weight of the casing produces the tight closing of the well hole at that point, so as to positively exclude the water and be not affected by the concussion of torpedoes, or by the jarring of the tools while drilling inside of the casing. The packing also admits of the easy pulling up of the casing without producing the turning of the packing.

Mr. John H. Gable, of Shamokin, Pa., is the inventor of an improved Condenser for Steam Engines of all kinds, in which a current of water is employed to condense the exhaust steam, and create thereby a vacuum that facilitates the running of the steam engine or pump, and gives it a greater percentage of power.

Mr. Sanford Hazen, of Ripon, Wis., has patented an improved Wind Engine, in which the vane is placed in such position to the wheel and tower that the mill may not be wrecked by the reaction of the wind, and in which the speed of the wheel may be regulated automatically or to any desired degree, the wheel being so constructed that any wing of the same may be readily removed and replaced with great facility for repairing or other purposes.

An improved Balanced Slide Valve has been patented by Mr. Walter R. Gluyas, of Cerro Gordo, Ill. This invention relates to the class of engine slide valves known as balanced valves; and it consists in the construction and arrangement of the parts of the valve and ports and passages in the valve chest and cylinder, whereby the valve is relieved from pressure and friction, so that little power is required to move it.

Mr. Joseph S. Badia, of Philadelphia, Pa., has patented an improved Automatic Feed water Regulator for steam boilers that accomplishes three different objects at the same time, namely, to indicate the height of the water level in the boiler, to give a whistle alarm when the water level is either too high or too low, and, finally, to act as an extractor of the air accumulating in the feed pump.

Mr. William Y. Rohrbach, of Kribb's Farm, Pa., has patented a Cover for Casing Heads of Oil Wells, in which the guide hole for the tubing is made with an outward taper or flare toward the upper and lower edges of the hole; and it consists, secondly, in a cover with two top lugs for preventing the clamps or elevators from spreading.

Mr. William Irelan, of Oak Springs, Iowa, has devised an improved Truss Bridge, that is made of a number of connected sections, the braces of which are so attached to each other as to be readily removed individually and repaired, when required, without the use of a trestle below the bridge.

An improved Compound Steam Engine has been patented by Mr. Albion Vile, of Southampton, England. This invention relates to improvements in compound engines of that kind in which the piston of the high pressure cylinder is made to act as the valve to open and close the ports leading from the high pressure to the low pressure cylinder or cylinders for controlling the passage of the steam from the

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one to the other. The steam, after it has acted on the piston of the high pressure cylinder, is passed directly into the low pressure cylinder or cylinders without the intervention of any slide valve between the cylinders, and without exhausting into jackets or receivers of any kind.

A Smoke Consuming Furnace.

The plans proposed and tried for consuming all smoke under boilers are as countless almost as are the boilers in use, for every engineer and every fireman of a few years' experience has his pet theory and practice on the subject, and yet boiler smoke stacks continue to pour out volumes of smoke, to the annoyance and discomfort of their neighborhoods.

It is well and widely known that fuels are consumed with the greatest possible economy when all of their combustible products enter into combination with enough and no more atmospheric air than is needful to supply the combining oxygen; and as a product of this knowledge we have the various practices of introducing air into the fireplace, and at other points along the combustion flue, to mingle with and consume the smoke and gases. Excepting in very rare instances these methods fall far short of effecting the purpose for which they were designed, for the reason principally that the cooling effect of the air has not been sufficiently considered. In the most successful cases the air is made to circulate through the heated walls of the boiler furnace before it is introduced into the combustion flue to mix with the unconsumed gases and smoke, and to the recognition of this fact we owe a recent invention, which designs to place a fire at each end of the boiler, and to alternately pass the smoke and gases from the one fire, as it receives a fresh charge of coal, over the other, which is in a state of full combustion.

According to another plan of some merit, several bridges, alternating with narrow arches thrown up nearly in contact with the under surface of the boiler, are arranged along the combustion flue, with the effect of producing a more intimate mingling of the air and gases by frequent deflections and disturbances of the current, and of increasing the heat radiating surfaces.

But all the conditions requisite for complete combustion are not secured simply by a mingling of the smoke, unburned gases, and atmospheric air, no matter how thoroughly this may be done; for it must be borne in mind that all of the boiler surface exposed to the flame is constantly absorbing the heat thereof to an extent that rapidly cools the burning gases to a point at which their combustion ceases, and unburned carbon or smoke is deposited or produced, and that this is the chief cause of trouble even when the firing is most skillfully done.

The question then seems to be, Can economical and complete combustion be secured before the gases are brought in contact with the heat absorbing surface of the boiler?

Every one has observed that highly heated furnaces in rolling mills give forth no smoke unless it be for an instant, when fresh coal is thrown on the fire; and the reasons for this are that an abundance of air is always given to the fuel which lies thickly on the grate, and that the temperature is maintained by the heat radiating interior surfaces of the furnace at the combustion point of the gases.

We readily admit that it would not be possible or economical to supply all boilers with a furnace attachment simply for the purpose of securing perfect combustion, but the correctness of the principle of supplying additional heat radiating surfaces to boilers cannot be questioned, and it has, to our knowledge, been applied in more than one instance in a very simple manner and with complete success.

In these instances the grate surface has been slightly narrowed by building up on each side of the fireplace thin walls of fire-brick extending three or four feet back from the feed door, and from these walls a rather flat fire-brick arch has been thrown over the whole grate surface—the crown of the arch reaching to within an inch of the crown sheet of the boiler—thus practically forming, within the combustion flue or flame space of the boiler, a reverberatory furnace, which an hour's firing raises to a white heat.

Each fresh supply of coal required is thrown just within the fire door, which is then quickly closed, and pushed forward and leveled with a light tool introduced through a register in the door; in this way any great access of cold air to the combustion chamber is avoided, while a gradual presentation of fresh coal to the fire is secured.

The radiation from the fire surface and heated side walls and arch forms a focus of intense heat which insures a proper temperature to the admitted air and complete combustion of the smoke and gases before they come in contact with the boiler; and consequently there is no escaping smoke, while there is nearly perfect utilization of all the products of combustion.

At first thought it might be objected that as the crown sheet of a boiler is the most effective heat absorbing surface, it being ordinarily exposed to the direct heat of the fire, whatever interferes with this action must be false practice; but further consideration will convince that the heat radiating arch secures a more even temperature about the whole boiler, and at the same time protects the crown sheet from the usual excessive wear or deterioration, thereby prolonging the life of the boiler, and that all of the heat excepting what is utilized for the draught must do the work for which it is intended.

It will be evident that by this thorough combustion, a very considerable saving in coal must be effected, and that, in many instances, a cheaper quality can be used, while the deposit of non-conducting matter in flues and tubes will be reduced to a minimum. The character of the coal used chiefly determines the proper length for the arch; very fat bituminous coals requiring an arch of from four to six feet, while a length of from three to four feet will, in most cases, be sufficient to secure the desired result.

Undoubtedly correct in principle—substituting heat radiating for heat absorbing surfaces at the fire end of the boiler—this plan should meet with general acceptance and relegate to the past the long endured smoke nuisance.

Natural History Notes.

Influence of Electricity on Plants.—Some interesting experiments as to the influence of atmospheric electricity on the nutrition of plants have lately been made by M. Grandeau, and communicated by him to the Academy of Sciences, of Paris. He placed two plants of the same species (tobacco, maize, wheat) under the same conditions as to soil, aeration, isolation, etc., but the one withdrawn from the action of atmospheric electricity by means of a Faraday's cage. The plants thus withdrawn elaborated, in equal times, 50 or 60 per cent less of living matters than the others. Plants of small elevation above the ground are also affected by atmospheric electricity. The centesimal amount of proteic matter formed appears not to depend sensibly on this action; it is proportional to the yield. The proportion of ash is higher in plants removed from the electricity, and the proportion of water is less. The French scientist, however, does not explain why it is that two plants of the same species, growing in a field side by side, and under the same conditions, do not always attain the same development nor elaborate the same amount of material from the soil.

Tropical Butterflies.—Mr. Wallace, in his recent volume ("Tropical Nature"), destroys some of the illusions of those who have never traveled in the tropics, as, for example, that the flora of these latitudes presents a dazzling brilliancy of color. On the contrary, foliation is the most prominent feature, and a conspicuous mass of blossoms, when occasionally met with, forms merely "an oasis of color in a desert of verdure." The next most general characteristic of a tropical forest is the apparent absence of animal life; for although an immense variety of forms is actually present, they are so widely scattered and shy as to require careful search to detect them. This, too, was the experience of our American explorer of the Amazons, the late Professor Orton. A striking exception to this rule, however, is presented in the case of the butterflies, which are not only numerous, but extremely conspicuous from their size and gorgeous coloring. Of these the author says: "Their aspect is altogether different from that presented by the butterflies of Europe and most temperate countries. A considerable proportion of the species are very large, six to eight inches across the wings being not uncommon among the *Papilionidæ* and *Morphidæ*, while several species are even larger. This great expanse of wing is accompanied by a slow flight; and, as they keep near the ground and often rest, sometimes with closed and sometimes with expanded wings, these noble insects really look larger and are much more conspicuous objects than the majority of our native birds. The first sight of the great blue *Morphos* flopping along in the forest roads near Para, of the large white-and-black semi-transparent *Ideas* floating airily about in the woods near Malacca, and of the golden-green *Ornithopteras* sailing on bird-like wings over the flowering shrubs which adorn the beach of the Ké and Aru Islands, can never be forgotten by any one who has a feeling of admiration for the new and beautiful in nature."

The "Poison Upas" Tree.—Among the numerous fictions regarding the animal and plant world that still go to form the staple of "popular science" compilations for the village library, that regarding the pestiferous exhalations from the "poison upas" is prominent. The erroneous and exaggerated statements respecting the upas tree (*Antiaris toxicaria*) are due to a Dutch surgeon, Dr. Foersch, who circulated them about the close of the last century. The tree was described as "growing in a desert tract, with no other plant near it for the distance of ten or twelve miles. Criminals condemned to die were offered the chance of life if they would go to the upas tree and collect some of the poison. They were furnished with proper directions, and armed with due precaution, but not two out of every twenty ever returned." Dr. Foersch states that he obtained his information from some of the survivors who had been lucky enough to escape, although the ground was strewn with the skeletons of their predecessors; and such was the virulence of the poison that there are no fish in the waters, nor has any rat, mouse, or other vermin been seen there; and when any birds fly near the tree, so that the effluvia reach them, they fall dead, a sacrifice to the poison. These statements having been quoted by Dr. Darwin in his "Botanic Garden," were thence disseminated through Europe.

The upas is a tree often attaining a height of over 100 feet, and found native in the islands of the Indian Archipelago. The stamens and pistils are found on separate flowers on the same tree, or, botanically speaking, the plant is *monœcious*. The tree belongs to the natural family *Artocarpaceæ*, the plants of which almost all abound in juices that are deleterious to a high degree; although it includes many that are extremely useful to man in many ways, among these, for instance, the famous cow tree, which yields a rich and wholesome milk; the *Ficus Indica*, which produces gum shellac; *Ficus Carica*, producing figs; *Morus*, or mulberry tree, etc. The upas tree, when pierced, exudes a milky juice which contains an acrid virulent poison, called *antiarin*. This, when dried, forms a poison in which the natives dip their arrows. As specimens of the tree have long been cultivated in botanic gardens, the reports regarding its venomous exhalations are known to be as erroneous as those will be some day that at present ascribe to *Eucalyptus* the power of emitting febrifuge exhalations.

The mistaken notion that long connected this noxious property with the upas arose from the fact that the tree occasionally grows in certain low valleys, in Java, rendered unwholesome by an escape of carbonic acid gas from crevices in the ground, and emitted in such a quantity as to be fatal to animals that approach too closely. These poisonous valleys are connected with the numerous volcanoes of the island. According to Reinwardt, sulphurous vapors are given off in such abundance from the craters of some of these volcanoes as to cause the death of a great number of tigers, birds, and insects; while, in some cases, the rivers and lakes are so charged with sulphuric acid that no fish can exist in them. The upas tree, therefore, although there is no doubt as to its inherent poisonous nature, has had to bear the reproach really due to volcanoes and their products.

Fecundity of the Queen Bee.—Baron Berlepsch, in several different experiments made to find out how many eggs are daily deposited by the queen bee, discovered that she laid 1,604 eggs in twenty-four hours, as the result of the first. In the second, she deposited on an average 1,913 daily, for the space of twenty days. In the third one, an average of 2,400 daily was found for the same length of time. In the fourth, she deposited 3,021 in twenty-four hours. She was seen by him to deposit 6 eggs in one minute. A writer in the *National Live Stock Journal* states that a gentleman told him, at the Illinois State Fair, that he had known a queen to deposit an average of 3,800 eggs daily for several days. As to his own experience, he had known 1,500 eggs to be deposited within the short space of four hours.

The Ascent of Sap.—A theory as to the rapid ascent of sap in the tissues of plants has recently been brought forward by M. J. Boehm. It is based upon the elasticity of cells. He states that "when the surface cells of a plant have lost a portion of their water through evaporation they are somewhat compressed by the air-pressure. Like elastic bladders, however, they tend to resume their original form, which is only possible by their taking in air and water from without. Since moist membranes are little penetrable by air, the outer cells draw from the cells which are further in a portion of their liquid contents. These, in turn, borrow from their neighbors further down, which contain more water, and so on, either to the extreme root cells or to those parts of the stem which are supplied with water from below through root pressure."

The Migrations of a Parasitic Worm.—Among the hosts of animal forms that live as parasites on or in other animals, there are certain worms which are free when young, and become parasites only at a later period of their evolution. For example the Guinea worm (*Filaria medinensis*) is the terror of travelers who visit the coast of Guinea; it is not only common on the west coast of Africa, but has recently been found in Turkistan and South Carolina. This worm undergoes its final development in the subcutaneous and intermuscular cellular tissue of man, and attains a length of 12 feet. It has been ascertained that the parasite, as a microscopic embryo, is transmitted by means of the cyclops, a little fresh water crustacean. In 1824, Deslongchamps discovered in the fatty matter of the common cockroach a great number of small lenticular bodies visible to the naked eye, to which he gave the name of *Filaria rytipleurites*. This encysted worm represents simply the asexual state of a nematoid whose migrations up to the present time have been unknown. *Les Mondes* gives place to a note from M. Osman Galer, who has traced the history of the parasite. He states that he made use of rats, which he fed on cockroaches infested with the parasites. At the end of eight days, having killed the three rats put to the experiment, he found in the mucous membrane of their stomachs the nematoids in question, living, and free from their envelopes. In one of the rats he found three females and a male, all of which had acquired their reproductive organs. Thus is accomplished the last stage of their evolution. Impregnation takes place in the digestive tube of the rat, and soon after the eggs which are laid pass out with the fecal matters. These eggs are swallowed by the cockroach; the embryos hatch out then in the digestive tube of the insects, pierce its walls, and encyst themselves in the fatty matters to wait till the cockroach is in its turn eaten by the rat, in which it is to finish the cycle of evolution.

The Sago Palm (*Sagus rumphii*) often forms great forests upon the islands of the Indian Ocean and Moluccas, and is there easily propagated by suckers. The white inner part of the stem, thickly permeated by bundles of fibers, abounds in a marrowy substance, which, when baked into bread, furnishes a daily food to the inhabitants of most of the southern and southeastern parts of Asia. This, in the form of flour and granules, is widely distributed in commerce under the name of "sago." One trunk of the age of fifteen years will sometimes furnish 600 lbs. of sago. A similar use is made in the same countries of the mealy sago palm (*Sagus farinifera*). In this connection, too, we may mention the Mauritius palm (*Mauritia flexuosa*), which, on account of its pithy stem, containing a sago-like meal before flowering, is also called the sago palm of South America. It grows from the mouth of the Orinoko to the Amazons, and also in Central America; and the mealy pith serves the Indians of these countries as a chief article of food.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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Expectant Advertisers will serve their interests by consulting C. K. Hammitt's Advertising Agency, 206 Broadway, N. Y.

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The SCIENTIFIC AMERICAN Export Edition is published monthly, about the 15th of each month. Every number comprises most of the plates of the four preceding weekly numbers of the SCIENTIFIC AMERICAN, with other appropriate contents, business announcements, etc. It forms a large and splendid periodical of nearly one hundred quarto pages, each number illustrated with about one hundred engravings. It is a complete record of American progress in the arts.

The only Engine in the market attached to boiler having cold bearings. F.F.& A.B.Landis, Lancaster, Pa.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, N. Y.

Alcott's Turbine received the Centennial Medal.

NEW BOOKS AND PUBLICATIONS.

HEUSINGER, "MUSTER-CONSTRUCTIONEN FÜR EISENBAHNBAU UND BETRIEB."

We acknowledge the receipt of two parts of a new work, issued by the Helwing Publishing House of Hanover, Germany, and edited by E. Heusinger von Waldegg, a well known German railroad engineer and editor of a technical journal for railroad construction. The work is of a serial character, and called by the editor "Muster-Constructionen (normal designs) for Railways and Rolling Stock." The parts contain a number of specially selected and approved constructions, one series being devoted specially to the building of the roadway, depots, switches, signaling devices, etc., while the other series contains designs for locomotives, rolling stock, and accessories. The work is intended for the use of railroad engineers, to assist them in their labors and furnish them with approved references. It is also of advantage to beginners, as it supplies them with designs of practically tested constructions. The work, however, does not embrace bridge constructions, as these have heretofore been separately collected by Klein, Heinzerling, and others. Of interesting and ingenious constructions relating to the roadway, we may mention a wire drawgate for road crossings (system Tronchon) and a station signaling apparatus, adopted by the Hungarian state railways. In the other class a sleeping car, built for the Finnish state railway, and a tender locomotive, built by the "Winterthur Locomotive Works" for the Töss Valley Railroad, may be mentioned. The lithographic plates of each part are executed in an exceedingly clear and creditable manner, and form with the descriptive text (in German) a live work for railroad engineers and technical libraries.

THE WORKS OF SHAKESPEARE. New York: T. Y. Crowell. 1 vol. 12mo. pp. 1097. Price $1.25.

Too often cheap editions of voluminous writers are badly made, illegible, and of uncertain text. This edition of Shakespeare appears to be a notable exception. The text is that of Clark and Wright, following generally that of their "Cambridge Shakespeare." The paper is fine and clear; the type, though necessarily small, is sufficiently distinct; and the book is well printed. There is added a copious glossary, an index to familiar passages, and an index to the characters in each play. Altogether the publisher seems to have been successful in his design to furnish an edition of Shakespeare combining the advantages of a reliable text, convenient size, clear type, and a moderate price.

Notes & Queries

(1) C. M. asks: 1. Can any more heat be communicated to the air of a small room, so as to be indicated by the thermometer, by the burning of gas or kerosene oil in a stove or other radiator than can be produced by burning the same amount of gas or oil in any other way, provided that the combustion is equally perfect in each case? A. You would get the greatest effect by using a radiator. 2. Is there any other advantage of the stoves as heat producers than having a tolerably good conductor in a convenient place? A. Yes. It renders combustion controllable, and makes it more perfect than it would be in an open fireplace.

(2) E. D. P. writes: In SCIENTIFIC AMERICAN of July 27, page 59, G. S. H. wants to know how to transplant large trees successfully. He can do it as follows: Dig a hole this fall large enough and deep enough to receive it. Then after the ground freezes this winter as far down as the roots are, dig around the tree until you get below the frost, then under tree, and turn it over on sled and haul to place, and set up, then in spring fill in to suit. In this way you do not disturb the roots in the least as the ground is frozen tight around them.

(3) A. S. M. asks for a good compound for taking the scale off and to prevent lime settling in steam boilers. I would like to know of something cheap and practicable. A. If the boiler is not a very small one, you may add once a week about one pound of soda (sodium carbonate) for every 50 gallons of the boiler's contents, taking care to blow out (through the bottom blow-out tap) this charge with the accumulated sludge before adding more, and meanwhile do not let the water run low in the boiler. The common practice is to use the blow-out while at work; but it is better to wait until after the boiler has been for a time quiet and the suspended matter has nearly settled.

(4) H. writes: I am building a bicycle with round rubber tire one inch in diameter. The ordinary rubber cement is not strong enough to hold the joint of tire. What shall I use, and how apply it? A. You may try the following: Melt together in a suitable iron vessel gutta percha and pitch, in about equal proportions, over a gentle fire, stirring until a homogeneous mass is obtained. Use warm.

(5) H. S. asks for a recipe for embalming bodies so that they will keep some time in this hot climate, either by rubbing it on the outside or injecting it inside, with full instructions how to apply it. A. See pp. 271 and 103, SCIENTIFIC AMERICAN, vol. 37, and p. 136, "Science Record" for 1874.

(6) W. L. A. asks: Will you please tell me what polishing ink is used for? A. See p. 316 (4), SCIENTIFIC AMERICAN, vol. 38.

(7) M. D. L. asks for a recipe for making a gum same as is used on postage stamps, in order to use it to fasten labels on microscopic slides. A. Dissolve 2 ozs. of dextrin in 5 ozs. of hot water, and 1 oz. of acetic acid, and 1 oz. of spirits of wine.

(8) P. J. F. asks: What is the difference between benzine and gas naphtha? A. Pure benzine (C_6H_6) is obtained in the fractional distillation of coal oil. The same name is given to several of the lighter distillates of petroleum (between 176° and 194°). The name naphtha is used to designate a mixture of several of the lighter distillates of petroleum. It is also applied to several of the distillates of coal oil after benzine. The least volatile portions of these contain the hydrocarbon xylene (C_8H_{10}).

(9) A. J. W. writes: When the double glasses of an opera glass get clouded between them, how can they be got apart to clean them? A. Soak them in turpentine. When separated clean thoroughly and cement together with a fine quality of balsam of fir.

(10) P. L. asks: Can electricity harm a bird that might be sitting on a telegraph wire? A. No.

(11) A. J. C. asks if there would be any difference in two thermometers hung up, one in the draught of the wind and the other where there is no draught. A. The one in the draught would probably indicate a lower temperature.

(12) W. J. B. asks: How is galvanizing on cast iron generally done? If by a battery, how is it made? If they are dipped in melted zinc (zinc galvanizing is what I refer to) how are the castings prepared? How is the superfluous zinc removed after they are dipped? A. Clean the work thoroughly by pickling it in dilute sulphuric acid, and scouring, if necessary, pass through a strong bath of aqueous zinc chloride solution slightly acidified with hydrochloric acid, and then through a bath of molten zinc covered with sal ammoniac.

(13) G. R. B. asks: 1. How many ohms resistance should the magnets of a relay be to operate on a line 2 miles long? A. Make the resistance of the relays equal to the resistance of the rest of the circuit, including batteries. 2. Which would give the best results on said line—to operate two bells, to use a relay, or operate the bells directly? A. Better use a relay. 3. Are there any tables by which the resistance of any given length of copper wire may be known? A. You will find such tables in works on telegraphy.

(14) G. E. A. asks (1) if fruit, vegetables, or meats will keep in their natural state if placed in a vessel and the air exhausted. A. For a limited time, yes. Efforts in this direction have not been very successful. 2. Also, is it necessary that the vessel should be placed in such a position that the air is taken from the lowest extremity? A. No.

(15) A. M. S. writes: I have tried to make an electro-magnet, but failed. I made the staple of horseshoe iron, 3 inches long, ⅜ inch diameter, wrapped with iron wire known as broom wire, insulated with black paint. The wire was wound up and down four times, making the wire 4 thicknesses, connecting it to a good strong battery. A. Use silk or cotton covered copper wire.

(16) G. V. B. asks: How can I polish a glass lens which has been scratched badly by carrying in the pocket with other articles? A. If the scratches are not deep stretch a piece of silk over the face of the lens, and apply to it a ball of sealing wax that is warm enough to take the form of the lens when it is pressed on the silk. When the wax is cool remove it and the silk together from the lens and coat the silk with a paste of putty powder. Rub the face of the lens with the instrument thus made, giving it a gyratory motion. Keep the putty powder moist.

(17) C. H. H. & Co. write: We have a large quantity of silver dissolved in diluted nitric acid; we wish to use it for casting silver ornaments. How can we recover it in proper form to use? A. Add muriatic acid to the solution until all the silver is precipitated as chloride, and after settling decant the supernatant liquid, cover the precipitate with a little dilute oil of vitriol, add a few fragments of clean zinc, and allow to stand for an hour. Soluble zinc chloride and sulphate is produced, and finely divided silver remains, which, after washing and separating from any undissolved zinc, may be fused in a crucible with a little sodium carbonate.

(18) J. E. L. asks: Please give me the names and amounts of the various ingredients which compose the composition used in reducing the temperature to or near the freezing point. A.

Mixtures.	Parts by weight.	Reduction of temperature.
Sodium sulphate	8	48·6° F.
Hydrochloric acid	5	
Pounded ice	2	50·4°
Common salt	1	
Sodium sulphate	3	52·2°
Dilute nitric acid	2	
Sodium sulphate	6	64·8
Ammonium nitrate	5	
Dilute nitric acid	4	
Sodium phosphate	9	70·2°
Dilute nitric acid	4	
Ammonium chloride	4	40°
Potassium nitrate	4	
Water	8	
Ammonium nitrate	1	46°
Water	1	
Ammonium nitrate	6	71°
Sodium phosphate	9	
Diluted nitric acid	4	

See also p. 1420, No. 89, SCIENTIFIC AMERICAN SUPPLEMENT.

(19) G. W. W. asks: What is the best way to spray on to an article to freeze it? A. See recipes for freezing mixtures above. For ice machines, see pp. 159 and 387, vol. 38, and 95, 168, and 335, vol. 37, SCIENTIFIC AMERICAN.

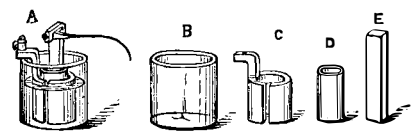
(20) C. W. L. asks: Is there any easy and convenient method by which salicylic acid could be used to keep meat and fruit in a private family, where no apparatus would be desirable that would have to be provided on purpose, or is there any treatise on the subject? A. See SCIENTIFIC AMERICAN SUPPLEMENT, p. 1051, No. 66.

(21) E. N. H. asks if there is any preparation which will remove hair from animal bodies and prevent its further growth, yet can be used with safety. A. See p. 91 (1), current volume, SCIENTIFIC AMERICAN.

(22) M. S. C. asks: Does the water in a boiler, under ordinary circumstances, roll or stand still and level at a pressure of 60 lbs. or higher? Why is it that when the saw is started through a log at a saw mill, the water in the glass tubes, sometimes affixed to steam boilers, rises, while the steam gauge shows no lessening in quantity of steam? A. When steam is drawn rapidly from a boiler, a quick circulation takes place, and the water rises or pulsates. In boilers with small steam spaces this is especially noticeable, as the steam raises the water with it in its flow.

(23) L. S. C. writes: The steam launch Undine of this place, Willimantic, Conn., has run one mile in 5′ 6″. She is 20 feet long, 52″ beam, engine 4½″, cylinder 4″ stroke, screw 2 blades, 20″ diameter, 40 pitch. Has this time been beaten by a boat of her size? A. We think not. Would be pleased to hear from our readers.

(24) H. M. K., F. L. W., T. McT., and others.—A modified form of Bunsen's battery is shown in the engraving, in which A is an element complete, B is the jar, which should hold about a quart, C is the zinc, which may be made from sheet or cast metal. It should be amalgamated before use. To do this, first remove any grease or dirt, then dip it in sulphuric acid diluted with 9 parts of water, place it on a platter, pour mercury over it, rub it until it attaches itself to every



part of the surface of the zinc, and allow it to stand until the surplus mercury runs off. The porous cell, D, should fit loosely in the zinc and reach ¾ inch above it (a small porous flower pot will do for a cell). The carbon, E, half fills the porous cell and is about twice as high. It is best to buy the carbons, but that which comes from gas retorts may be used, or finely pulverized coke and caking coal may be mixed together and pressed strongly into an iron mould, and calcined at a low red heat. To set up the battery half fill the jar with a saturated solution of common salt, put in the zinc, place the porous cell in the zinc and the carbon in the porous cell. Fill the cell with a solution made as follows: Dissolve 1 lb. of bichromate of potash in 10 lbs. of hot water; when cool slowly add 5 lbs. strong sulphuric acid. Mix in a vessel that will resist acids and will not crack by heat. Clamp a wire to the carbon and attach a wire to the zinc. To make a powerful battery for occasional use, make zinc and carbon plates of equal size, and dip them, when a current is required, in a solution consisting of 2 parts of bichromate of potash, 20 parts of water, and 1 part of sulphuric acid. The bichromate solution is poisonous and should be handled with care.

(25) T. J. H. writes: I want a small fumigating apparatus for fumigating articles placed in a box or barrel, and that would burn, say, 1 lb. of sulphur at a time. Is there any such contrivance for sale, or how can I make one cheaply? A. All that is requisite, if we understand you, is a shallow earthenware dish large enough to hold the amount of sulphur it is desired to burn. It is best to fuse the sulphur before igniting it.

(26) Amateur writes: I purchased from a dealer some "red fire," so-called, for tableaux, and received a package of some reddish yellow powder, some white powder, and small vial of acid; a small quantity of reddish powder was first put on an old plate, a little of the white sprinkled on it, and then a drop or two of the acid was dropped on, when it immediately blazed up with a brilliant red fire. Can you tell me what they consist of, what kind of acid, and what the white and yellow powders were, and why it should inflame when the acid came in contact with the white powder? The yellow reddish powder also ignites with a match, but the dealer said that the latest way was with the acid, and there could be no danger. A. 1. Powdered resin and strontium nitrate. 2. Powdered potassium chlorate and dry sugar. 3. Strong sulphuric acid.

(27) F. F. O. asks: What will remove lead pencil marks from calcimined walls? A. Mechanical erasure only is possible; try a piece of clean rubber alone or supplied with a little whiting.

(28) H. W. H. asks how to combine India rubber and white beeswax, making the wax more tough and flexible for moulded articles. Would the rubber first be dissolved in naphtha or other solvent, and united with the melted wax, or can the union be made more direct? A. It will probably be more satisfactory to soften a little both the substances with benzole or benzolene, and knead them thoroughly together while warm.

(29) F. R. M. asks how to test diamonds, that is, how to tell the genuine from glass. A. The specific gravity of the diamond is 3·52 (silicious pebbles =2·5 to 2·8); readily scratches quartz, topaz, and corundum—not scratched by either. Refracts and disperses light powerfully (index of refraction 2·439), and, after exposure to sunlight, is phosphorescent in the dark. Not affected by hydrofluoric acid. Crystalline form (uncut) regular octohedron, usually with curved faces.

(30) E. M. F. asks for a good recipe for shoe blacking; must mix close and dry hard without cracking. If not too much trouble, I would like to know the order in which the ingredients are combined and the proportion of one to another. A. See pp. 27 (17) and 300 (45), vol. 38, SCIENTIFIC AMERICAN.

(31) A. M. Y. writes: Having two cubes or spheres of equal dimensions outside, one to be solid of a light material, the other a shell of a heavier material, that they may be of equal weight, would their buoying qualities be equal? A. Yes.

(32) C. P. T. asks: What kind of salts are best adapted to the neutralization of the sulphur and gases arising from bituminous coal during combustion? A. The hydrates of the alkali and earth metals—soda, potash, lime, etc.

How can I make the strongest and most lasting solution of iron? A. If we understand you, dissolve the iron in a warm mixture of 1 part nitric and 5 parts hydrochloric acid, evaporate the solution to dryness, and dissolve the residue in water slightly acidified with hydrochloric acid.

(33) "Bronze" asks: Is there a recipe known to you for a preparation for bronzing old gas fixtures, one that could be put on as paint is (with brush) without heating the fixture? A. There is a varnish in market which is made expressly for this purpose.

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MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. B. B.—Feldspar and hornblende rock.—J. N. B.—It is phlogophite—magnesia, alumina, potash silicate—a variety of mica.—I. H. P.—Sandstone with a little mica—not specular iron.—No name, 6 specimens: Nos. 1 and 2, black jasper; 3, decomposed orthoclase; 4, chert—an impure variety of quartz; 5 and 6, fine quartz conglomerate containing much iron sulphide.—S. R. T.—Principally aluminum and magnesium silicates colored by ferrous oxide.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges with much pleasure the receipt of original papers and contributions on the following subjects:

Physical Characteristics of Ether. By W. D.

Patent Litigation. By D. V. E. N.

HINTS TO CORRESPONDENTS.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Many of our correspondents make inquiries which cannot properly be answered in these columns. Such inquiries, if signed by initials only, are liable to be cast into the waste basket.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

June 18, 1878,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Ammonia or ether machine, Moreau & Haggerty. 205,120
Apple corer, J. A. Morrow 205,122
Auger handle, W. A. Ives 205,096
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Propellers.—B. B. Brewer, Sacramento, Cal.

Window cleaner.—E. P. Hall, Chicago, Ill.

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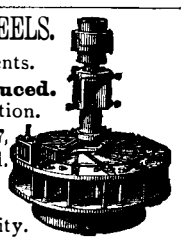

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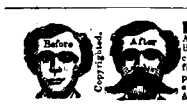

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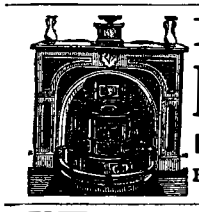

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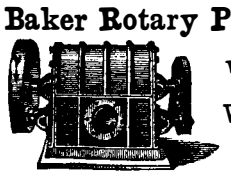

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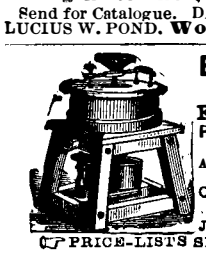

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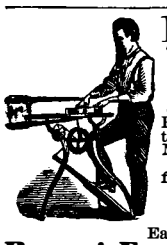

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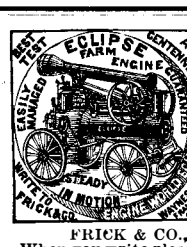

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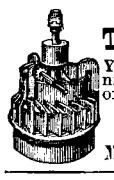

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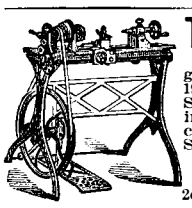

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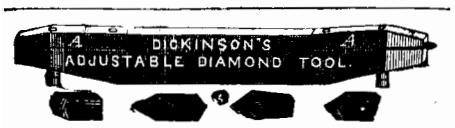

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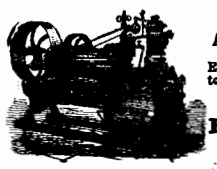

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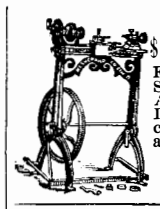

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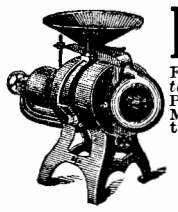

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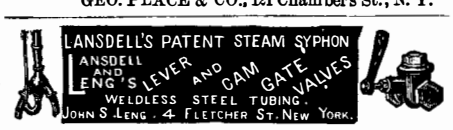
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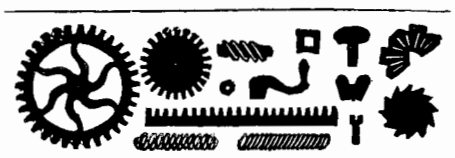

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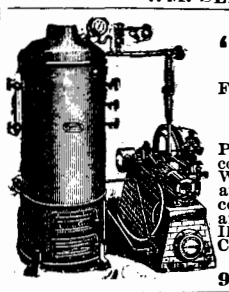

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